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COLONY AND PROTECTORATE OF KENYA

Department of Agriculture Annual Report 1930

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DEPARTMENT OF AGRICULTURE
ANNUAL REPORT
1930

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ANNUAL REPORT OF THE DIRECTOR OF AGRICULTURE

FOR THE YEAR ENDED 31st DECEMBER, 1930

Staff, etc.

The principal staff changes are shown in Appendix I.

The most important change which occurred during 1930 was the transfer of Mr. E. Harrison, the Deputy Director, on promotion to Tanganyika Territory as Director.

The new post of Deputy Director (Plant Industry) was filled by the transfer of Mr. H. Wolfe from Tanganyika Territory, who arrived in the Colony in November.

Other important additions to the staff included four Agricultural Officers (one temporary), one of whom has been posted to the Scott Agricultural Laboratories for investigational work on pasture improvement and for the plant introduction services. At a time when many farmers are turning more to mixed farming, pasture research becomes of great importance, and in the present state of world over-production of the staple crops much more attention must be given to the possible exploitation of hitherto untried crops, which may prove of great value to the Colony. The appointment of this officer will strengthen these lines of work which hitherto have not received the attention they merit.

The scientific staff has been further strengthened by the appointments of an Entomologist and a Mycologist.

In the Veterinary Divisions the most important changes have been the loss of Dr. S. H. Whitworth, on transfer to the West Coast, and the appointment of Dr. E. A. Lewis, Veterinary Entomologist, for special investigational work on ticks and tick-borne diseases.

In view of the urgent need for economy, very few new services are being undertaken in 1931, but the post of Agricultural Economist will shortly be filled.

The value of periodical conferences between officers engaged on similar lines of work is becoming more appreciated. These conferences are now considered essential, and are regularly held. Apart from the value of the official discussions round a table, and the formulating of combined lines of research which obviate overlapping and ensure unity of aim, the informal discussions which take place between officers from the various parts of the Colony are of great importance, and allow personal contact to be kept between the field officers and the research and scientific staff and headquarters.

Arrangements were again made this year for officers of the Department to meet and address meetings of Farmers' Associations and kindred bodies. In a Colony such as this, it is essential for the agricultural staff to obtain personal contact with farmers, as only by so doing can they fully grasp the manifold difficulties and problems that constantly confront the farmer, and while it is not always possible, owing to limitations of time, to make the personal acquaintance of all, these meetings enable the officers to meet representatives of districts who are thus able to expound local conditions and to receive first-hand advice and encouragement on them. In this connexion it is gratifying to note the increasing interest in the experimental work being carried out by the field staff in the Rift Valley and Plateau areas, as well as at Njoro and the Scott Agricultural Laboratories.

An event of importance to the Department and to the agricultural community of the Colony was the visit of the Agricultural Adviser to the Colonial Office, Mr. F. A. Stockdale, who arrived late in December. Mr. Stockdale is to present a report on his visit to the Secretary of State for the Colonies, and reference to this will be made in the next Annual Report.

Another event of importance to the agricultural industry was the establishment, in April, of the Board of Agriculture, which was one of the recommendations of the Agricultural Commission which sat under the chairmanship of Sir Daniel Hall in the latter months of 1929. The Board is investigating a number of local agricultural problems, those of major importance taken to an advanced stage during 1930 being :—

(*a*) Agricultural credit.

(*b*) Cost of production of maize, wheat, coffee and sisal, and schemes of financial assistance for growers.

(*c*) Organization of marketing for dairy produce.

Memoranda on these matters were submitted to Government by the Board.

Other important events were the establishment of agricultural credits, under the Agricultural Advances Ordinance for the agricultural industries generally and under the Maize Subsidy Ordinance for the maize industry. Reference is made to these later in this report.

Financial.

An analysis of Expenditure and Revenue is given under the following heads :—

1. Agriculture (other than Veterinary)—
   (*a*) Headquarters, Administration, Staff, etc.
   (*b*) Research.
2. Veterinary—
   (*a*) Executive Division.
   (*b*) Services of Veterinary Laboratory.

This statement is exclusive of the special expenditure of £44,075 for relief of the grain industry, £2,640 for maize-drying plants at Kitale and M'baraki, and £5,635 for locust services.

	1928	1929	1930
1. AGRICULTURE (other than Veterinary).—	£	£	£
(*a*) Headquarters Administration Staff etc.	17,038	19,152	20,939
Expenses of Board of Agriculture and Committees	..	..	1,863
(*b*) Other Services.—			
Native Agriculture	11,547	13,338	16,393
Coast Experiment Station	..	..	315
Scott Agricultural Laboratories ..	8,369	8,803	7,963
Coffee and Sisal Services	..	..	4,270
Plant Breeding Services	3,379	3,750	3,447
Grading, Conditioning and Cool Stores	5,460	5,776	12,242
Grants to outside bodies	3,273	6,042	6,963
Expenses in connection with Stephanderes	..	3,768	2,473
Control of Striga, pests, diseases etc.	..	..	570
Assisted Importation of Pedigree Live Stock	815	1,295	440
Ant Repellent	418	787	..
Cytological Research (East Coast Fever)	..	..	1,200
Gross Expenditure	50,299	62,311	79,078
Revenue	6,036	7,131	22,320
NET EXPENDITURE ON AGRICULTURE (other than Veterinary) .. £	44,213	55,180	56,758
2. *VETERINARY.—			
(*a*) Executive Division	50,652	54,117	52,588
(*b*) Research	30,532	38,361	36,432
Gross Expenditure	81,184	92,478	89,020
Revenue	27,707	39,424	30,682
NET EXPENDITURE ON VETERINARY SERVICES	53,477	53,054	58,338
TOTAL NET EXPENDITURE, AGRICULTURAL DEPARTMENT .. .. £	97,690	108,234	115,096

*These figures include the share of cost of Headquarters Office Services, *e.g.* Clerical, Accounts, Storekeeping, etc, rendered for "Veterinary." Accordingly £1,800 has been debited to Veterinary (Executive Division) and £200 to Veterinary Research.

It will be noted that the proportion which the net expenditure upon Veterinary Services bears to the total net expenditure of the whole Department has undergone a slight increase. It now stands at 51 per cent.

General.

The year was one of general world over-production of staple crops and the consequent depression has been markedly felt in Kenya.

The heavy rains of late 1929 produced large crops of maize and wheat, and these crops brought to an end the food shortage which had been more or less severe throughout the whole of 1929 in some Native Reserves, notably Meru, Embu and Kitui. The prolongation of these heavy rains, however, well into 1930 produced conditions in which it was very difficult to export the surplus crops as soon as available. Not only did the wet weather make it difficult to dry the crops sufficiently for export, but transport was disorganized and in many cases great delay was experienced in getting the crop away from the farm. New Grading Rules were promulgated on the 1st January, and inland inspection was inaugurated at Kitale and Nakuru by the end of that month. The first consignment of maize was received at the Coast on 15th January, and on the 28th January continuous working was started at the Conditioning Plant, the plant then running day and night until 19th November. While the capacity of the plant is sufficient for normal conditions, it soon became evident that very great congestion would occur. Not only was maize being harvested in a wet state, but dry maize actually absorbed moisture in the damp weather conditions. During the first three months of the year (the period over which in a normal season the bulk of wet maize is received) 41 per cent of the maize received at the Coast for grading was wet. Similar periods for the years 1927, 1928 and 1929 show percentages of 7.7, 6.2 and 14 per cent respectively. It was soon found that as, owing to the congestion, some maize had to wait as much as ten days or a fortnight in the sheds before conditioning, many consignments dried out sufficiently for export, and regrading was instituted to deal with such cases. Nevertheless, there were at times as many as 74,000 bags of maize, as well as quantities of wheat, awaiting conditioning.

Furthermore, the very wet conditions in the Trans Nzoia greatly delayed the putting of maize on rail, while at times during May, June and July, owing to peak traffic on the Railway, there occurred shortages of trucks available for maize

transport. In May it was estimated that of the total crop of 600,000 bags expected from the Trans Nzoia, only 200,000 had been exported.

All available paths were explored with a view to improving conditions, and it was decided to erect two emergency conditioning plants, one at M'baraki to relieve the congestion at Kilindini, and one at Kitale to deal with maize before being put on rail. The plant at M'baraki was first tested on the 26th June, and by July was dealing with 800 bags per day. Unfortunately, on the 2nd August the plant caught fire and was completely destroyed. The Kitale plant was by this time in running order, but a number of small outbreaks of fire showed that the plant was unsatisfactory and dangerous, and it was closed down on the 26th August.

Another result of the abnormal weather conditions was an increase in weevil infestation, and an entomologist was sent to the Trans Nzoia to report on the infestation and to test methods of combating the weevil. No satisfactory method was discovered which did not involve the use of airtight tanks, and the quantity of maize involved precluded any attempt to deal with the infestation as a whole by this method. The percentage of maize rejected at the Coast as weevilly throughout the year rose as high as 7.02, the figure for any of the previous three years being less than 1.5. In this connexion it should be remembered that maize containing about 14 per cent of moisture is more liable to weevil infestation than maize having a lower moisture content.

Financial Assistance for Industries.

Meanwhile, in the face of the world depression of prices, it became necessary that something should be done to assist the industry financially, and the whole question of the conditions of agricultural credits operating in the Colony came under review. This culminated in the Agricultural Advances Ordinance, 1930, the effect of which is discussed later in this report.

Refund on Grading and Inspection Charges.

Apart from the question of making further individual credits available to farmers in general, it was necessary to take some further emergency steps to assist the maize and wheat industries. Considerable relief was afforded when Government decided on the 21st July to refund four-fifths of the grading and inspection charges made upon the 1929-1930 crops of maize and wheat. In normal years the conditioning

plant dealt with 10 to 12 per cent of the maize and about 30 per cent of the wheat offered for export. This year, 30 to 40 per cent of the former and 70 per cent of the latter had to be reconditioned. The refund charges completely absorbed the profits that were in hand from previous years.

About the same time, the Kenya and Uganda Railways and Harbours remitted four-fifths of the Port storage charges, which were exceptionally heavy this year owing to the unavoidable congestion at Kilindini.

The reductions thus effected, calculated over the whole season, represented approximately 23 cents and 52 cents per bag in respect of storage charges and grading and conditioning fees respectively.

Efforts were continually made to obtain the co-operation of all parties interested in the industry to grant reductions in charges with a view to effecting economies, especially in transport, and the Conference Lines reduced ocean freights as from July 16th, subject to one month's notice, on maize first from Sh. 25 to Sh. 22/6d., then to Sh. 20 per long ton, and on wheat from Sh. 30, less 10 per cent, to Sh. 20.

Reference has been made to the Agricultural Advances Ordinance, 1930. It will be remembered that in the Report of the Agricultural Commission, 1929, Chapter III, the agricultural credit system of the Colony was discussed in the following terms :—

> " The question of credits for farmers has occupied the attention of most Governments. Agriculture is distinguished from all other industries by the very large proportion which the capital employed on a farm bears to the turnover, and again by the comparatively long lag between production and realization. The farmer has no access to the usual source of capital, for joint-stock companies engaged in farming are rare."

The Report then described the forms of credit available in Kenya. These fall under two heads :—

(*a*) *Long Term Credits*, which include essentially the provision of loans to assist the capital investment in a farm. These are usually effected by mortgages, which are available at not unreasonable rates of interest, but they have the great disadvantage of uncertain tenure.

(*b*) *Short Term Credits*, providing for immediate supplies of money necessary to meet current expenses of production, through the period of waiting for the realization on crops. This is normally provided either by the banks in the form of an overdraft, or by the merchants through whom the farmer eventually disposes of his crops.

Agricultural Advances Ordinance.

As a result of the bad season and depressed conditions in farming, credit facilities were becoming scarce, and in order to enable the normal rate of agricultural development to be maintained and to keep on the land efficient farmers whose prospects normally were good but whose financial position was, owing to these conditions, becoming precarious, it became necessary to evolve a scheme which should not compete with the existing facilities but should support and strengthen them.

The Agricultural Advances Ordinance, 1930, was passed on 31st May, and a Central Board was appointed on the 4th June, while local boards were appointed at Kitale, Rift Valley, Nyeri, Kisumu, Naivasha, Machakos, Eldoret, Nairobi and Mombasa. The local boards were to be merely advisory, the sole authority for approving and making advances being the Central Agricultural Credits Board in Nairobi.

A necessary corollary to this Ordinance was the provision of some form of Crop Lien Act, and this was effected in the Chattels Transfer Ordinance, 1930.

Provision was made for the sum of £100,000 to be available for advances under the Agricultural Advances Ordinance, and by the end of the year some £68,000 had been thus advanced.

Advances were made in various forms, the most important being the provision of monthly payments to cover the farmer's minimum working and subsistence expenses, thus keeping him solvent and enabling him to carry on the usual agricultural operations until such time as a return from his crops was available. In some cases, 50 per cent of trade debts were paid on condition that the traders concerned agreed to forbear to press for full payment for a period of up to three years, and in some cases also mortgage interest was met. By the end of the year, however, it was felt that to safeguard the advances already made, it would be necessary to continue to carry some of the farmers for several months more, and it was arranged

to carry over the balance of £32,000 remaining at the end of the year to 1931, to enable further advances to be made. It was generally felt and agreed that the timely introduction of this scheme, making advances as outlined above, had a steadying effect on a very panicky situation, which might easily and very quickly have led to something in the nature of a disaster.

By July, market prices of grain had dropped to a parity of approximately Sh. 5/55 per bag of maize (200 lb.), Sh. 9 per bag of wheat (200 lb.), and Sh. 2/20 per bag of barley (180 lb.) f.o.r. Kenya stations, and this collapse in the grain markets created a serious crisis. It was therefore found necessary further to assist the agricultural industry, and a Committee was appointed with the following terms of reference :—

> " To inquire whether any emergency form of assistance other than that afforded through the Agricultural Advances Ordinance, 1930, and the Chattels Transfer Ordinance, 1930, is immediately necessary to carry grain-growers through the present crisis, and, if so, to recommend in what form such assistance may most effectively be given."

Refund on Railway Rates.

As a result of the recommendations of this Committee, Government decided on the 28th August that in order to give further relief to grain-growers, in which the Railways and Harbours Administration were prepared to co-operate to the extent of bearing 50 per cent of the cost, a sum not exceeding £35,000 should be appropriated from the Colony's surplus balances to enable a refund to be made of the whole or part of the Railway rates and Port charges in respect of the maize, wheat and barley exported since January 1st from that season's crop (i.e. the crop harvested towards the end of 1929 and early in 1930), on the understanding that the refund in respect of maize, wheat and barley should be an amount up to Sh. 1, Sh. 2 and Sh. 3 respectively, provided that the total return to the grower should not exceed Sh. 8, Sh. 13 and Sh. 6 respectively. It was further stipulated that the Government had the right to demand repayment of the refunds made by it in form or manner to be decided later.

Towards the end of the year it became evident that world conditions were not likely to improve to any extent in the immediate future, and it was necessary to consider very seriously means of affording certain industries still further assistance during the forthcoming season. The question of

increased facilities for drying cereal crops for export was considered, and at a meeting of the Maize and Wheat Consulting Committee in October it was resolved :—

> " That in view of the experience with the Kitale experimental plant, no other plant be erected there or at any other internal centres, but that extensions be made at Kilindini, where proper control can be exercised.
>
> " That this Committee urges upon Government the immediate necessity of increasing the capacity of the conditioning plant at Kilindini, and is satisfied that the extensions proposed by the Director of Agriculture will meet the immediate requirements of the industry.
>
> " That this Committee appreciates the risk to the reputation of export certificates involved in the use by farmers of certain types of apparatus for the artificial drying of grain for export, and requests the Director of Agriculture to frame the necessary additions to the Rules to control the use of such apparatus."

Maize Subsidy.

A Maize Conference was convened by the Government in December with the following terms of reference :—

> " To inquire into the present state of the maize industry with a view to ascertaining whether by concerted action on the part of all interests concerned, practicable measures can be devised for assisting the industry during the present period of depression and, if so, to make recommendations accordingly."

The Report of the Conference and measures which followed upon it fall into the year 1931, but it may be stated here that assistance was given to the producers of the 1930 maize crop in general, not individually, by means of a loan subsidy on exports which averaged Sh. 1/63 per bag.

Wheat Pool.

During the year it became increasingly evident that some reorganization in the wheat and flour industry would be necessary to ensure its satisfactory continuation. Considerably lower prices were being obtained for exports than for sales for local consumption. The Colony produces a substantial surplus, and unless each grower was to be made to bear a share of the difference in price in accordance with his production, the local price would drop to almost a parity with the export price, and there was grave danger that many farmers might be forced out of wheat-growing.

An enabling bill to give Government powers to bring the interested parties together, with a view to securing some agreement for co-operation and to set up a controlling agency or agencies, was passed in September in the form of the Sale of Wheat Ordinance. It was emphasized at the time, and at all times during the subsequent discussions on this subject, that Government had no intention of operating or accepting any financial responsibility itself in connexion with the proposed pool.

In order to advise Government as to the steps to be taken under this Ordinance, a Conference, representative of all the wheat-growing, milling and marketing interests in the Colony was convened in Nairobi on the 3rd October. Considerable discussion took place on the Ordinance, and at times it was feared that interests were too opposed to produce any agreed recommendations. A resolution was, however, passed *nem. con.*, requesting Government to implement the provisions of the Sale of Wheat Ordinance, 1930, on certain understandings in respect of previous contracts. Resolutions were also passed recommending that Government should appoint a Board to advise in regard to the operations of the pooling agency or agencies, and that the Kenya Farmers' Association should be appointed the sole agency for the Colony. Government declined to appoint an advisory board with official members. The constitution of the Board was gazetted on 9th December, with Lord Francis Scott as chairman. The Board met at once and confirmed the draft Rules, which were then published as the Sale of Wheat (Agency) Rules, 1930, on the 30th December. The pool provided for in the Rules has been successful in avoiding disaster, but, with a further decline in the price of wheat, the pool price for the 1930-planted crop has been below the cost of production.

Land Bank.

The question of the institution of a Land and Agricultural Bank in Kenya for the giving of long-term loans to farmers, on first mortgage of land, has been the subject of discussion for some years, but by the end of 1929 no legislation had as yet been passed. The depressed conditions this year made it more than ever desirable that definite steps should be taken for the introduction of such a Bank, and legislation for this purpose occupied the attention of Government throughout the year, the Bill approaching its final form towards the end of the year. Owing to the urgency of the situation and the strong local desire to see the measure passed, the Secretary

of State agreed to allow the Bill to be taken by Legislative Council for its third reading before finally approving it. The Ordinance was thus passed in November, but by the end of the year had not received assent. [The Land Bank began its operations in July, 1931.] The operations of the Bank are to extend to native as well as non-native farmers, but loans to the former will not be possible until a different system of land tenure for natives is instituted.

Meteorological.

The meteorological services undertaken by this Department for twenty-five years were handed over to the East African Meteorological Service on January 1st, 1929, and assistance was rendered in some directions during that year. By the beginning of 1930, however, these services were completely outside the province of this Department.

A summary of the meteorological records for 1930 is appended hereto (Appendix IX), for which acknowledgment is due to the Director of the East African Meteorological Service.

Agricultural Statistics.

The eleventh Agricultural Census for the period August 1st, 1929, to July 31st, 1930, was compiled and published. This also served as a contribution to the World Census undertaken by the International Institute of Agriculture at Rome.

It was decided to alter the Agricultural Census date from that previously employed, that is, 31st July, and to bring it forward to the 28th February.

The statistical information given in the succeeding subsections of this report relates therefore to the twelfth Agricultural Census in respect of the period 1st March, 1930, to 28th February, 1931, and therefore principally to the year 1930. Comparisons with figures for the previous year are given from the census taken as at 31st July, 1929, and are therefore over a period of nineteen months.

It was further decided, in view of the simplification of the schedules employed, instead of collating the complete census triennially and an abbreviated one in intervening years, as previously practised, to take the complete census annually.

The following tables and appendices were submitted with the report :—

(1) Acreages under occupation, under cultivation, and of the principal crops harvested.

(2) Numbers of live stock, the property of Europeans.

(3) Classification of cattle, the property of Europeans.

(4) Deaths of cattle, horses, mules, donkeys, sheep, goats, pigs and poultry, the property of Europeans.

(5) Stock, the property of Europeans, slaughtered or sold for slaughter purposes.

(6) Animal products sold by European occupiers.

(7) Cereals, total production; acreage harvested and yield per acre of cereals (maize, wheat, barley and oats).

(8) Coffee, acreage planted, age of trees, and yield of clean coffee and *buni*.

(9) Tea, area planted, and production of tea.

(10) Sisal fibre, acreage planted, age of plants, and yield of fibre.

(11) Coco-nuts, acreage planted, number and age of palms, and production of nuts and copra.

(12) Wattle, acreage, age, and production of dry bark.

(13) Acreage and number of fruit trees, the property of Europeans, planted.

(14) Agricultural implements and machinery in the possession of Europeans.

(15) Number of native squatters resident on European holdings, and number of squatters' live stock on European holdings.

(16) Average number of units of labour (men, women and children) employed on agricultural holdings.

Appendix I.—Total district areas of the Colony and Protectorate of Kenya.

Appendix II.—Comparative quantities and approximate values of agricultural commodities exported from Kenya over a period of years.

Crop Reports.

The revised system of forecasting crop production and exports, inaugurated in 1928, was continued during the year, with satisfactory results.

The number of crop correspondents, who assisted in this service by submitting monthly estimates, was 223. Reports were published in respect of the months of January, February, July, August, September, October, November and December.

The thanks of the Department are due and tendered to the crop correspondents who regularly and promptly submitted monthly estimates of their crops, and by so doing enabled the Department to maintain this service, valuable alike to Government, Railways and Harbours Administration, shipping companies, trade and commerce, agriculturists and the public generally.

Imports.

Last year a table was given in the Annual Report of imports of foodstuffs, showing the extent to which these are not met by local production. Reference should be made to the 1930 Trade Report for 1930 figures. The position in respect of deficiency in local production has scarcely altered.

Exports.

The total value of agricultural exports, the produce of Kenya, in 1930 was £3,157,457, an increase of £773,554 as compared with the previous year. A comprehensive statistical statement, with comparisons with previous years, is given in the Census Report.

Acreage, Occupation and Development.

The total area allotted for occupation by Europeans is approximately 6,847,360 acres, and in addition an area of about 845,440 acres is still available for alienation. Of the area allotted, 5,389,965 acres are under occupation, showing an increase of 389,317 acres as compared with the preceding year. The number of European occupiers totals 2,106, a net increase of 71 over the previous year.

The number of Europeans employed on agricultural holdings, inclusive of the 2,106 occupiers, is returned at 2,775, a decrease of 107 as compared with the previous year.

The total area under cultivation is 659,380 acres, giving an average of 313 acres per occupier as compared with 312 and 301 acres for the years 1929 and 1928 respectively. Including land used for stock-farming, it is calculated that the area beneficially occupied is, on the average, 1,343 acres per occupier, which shows the extensive character of farming operations in the Colony.

In addition, considerable areas of farms are used by native squatters and employees. For statistical information and comparison with previous years, reference should be made to the Census Report.

Main Crops.

The total area under crops was 572,339 acres, and the total area under cultivation 659,380 acres. For comparative purposes, figures for the previous year are given, together with percentages of increase and decrease, in the following table :—

Crop	Acreage		Increase	Decrease
	*1930	†1929		
			%	%
Maize	200,926	245,807	..	18·2
Wheat	68,851	66,039	4·2	
Barley	1,967	14,543	..	86·4
Coffee	96,689	90,205	7·2	
Sisal	137,299	109,375	25·5	
Tea	10,052	5,593	79·7	
Coco-nuts	8,499	8,568	..	0·8
Sugar Cane	13,493	11,161	20·0	
Miscellaneous	34,563	28,543	21·1	
Total Acreage of Crops Grown	572,339	579,884	..	1·3

* In respect of the census period 1st March, 1930 to 28th February, 1931.
† In respect of the census period 1st August, 1928 to 31st July, 1929.

Maize.

Crop year	Acreage harvested	Production (bags 200 lb.)	Bags per acre	Quantity exported cwt.
1927–1928	177,009	1,088,706	6·15	805,081
1928–1929	204,945	1,099,317	5·36	912,561
1929–1930	233,973	1,858,586	7·94	1,429,094
1930–1931	200,926	1,649,728	8·21	

The heavy rains, considerably in excess of the average, had a great influence in raising yields in the drier maize-growing areas, but in the Trans Nzoia, which normally has an ample rainfall, the prolongation of heavy rain after planting in many cases deteriorated the maize by facilitating the growth of parasitic organisms.

The problems attending the harvest and export of the maize crop have been dealt with in an earlier section of this report.

Considerable attention has been paid this year by officers of the Plant Breeding Section to the effect of various diseases of maize in reducing the yields, both by reduction of stand and by subsequent but less obvious attacks leading to a reduction in general vigour of the crop. One is glad to note that the importance of this aspect of maize-growing is being realized more and more by the farmers, the majority of whom now make some effort to select seed with special regard to soundness. Much of the investigation carried on in the co-operative experiments has dealt with green manures and the maintenance of humus supply in the soil, and the importance of this side of cultivation is also being more appreciated.

Work on maize selection is being carried on at Njoro, at the Scott Agricultural Laboratories, and in other parts of the Colony, notably in the Kitale area. It is now thought that, in spite of the success which attended the planting of Njoro seed in warmer places, breeding for the main maize-growing areas should be continued under conditions similar to those of those areas, while at Njoro work should be concentrated on maizes suitable for the higher elevations. Further work is being done at Kitale in the selection of cobs for an inbreeding programme to obtain higher-yielding disease-resistant lines.

Work has continued on the selection of "Muratha" maize at the Scott Agricultural Laboratories, and quantities of seed of approved strains were issued for bulking in some of the reserves. The extreme weather conditions hampered selective work, and this work is to be continued during 1931.

Censuses of maize fields undertaken by the Plant Breeding Services revealed that poor seed, inferior planting, ragged stands, and bad cultivation have been responsible for substantial reductions in yield in most maize areas. A bulletin on the subject has been published. The storage of maize also requires improvement.

The maize seed competition, referred to last year, is to be promoted by the Royal Agricultural and Horticultural Society early in 1931. It is hoped that this competition will encourage those farmers who have selected their seed in the past, and will stimulate others to pay more attention to this very important aspect of maize cultivation.

The Kenya Farmers' Association maize-growing competition for the highest yield was won by Mr. J. E. A. Woolryche Whitmore, Rongai, with a yield over 25 acres of 29.92 bags per acre.

The objects of these two competitions are entirely different. That of the latter is success in growing maize; of the former, success in producing high-quality seed. The seed competition is designed to lead to a seed register for growers of reliable, high-yielding seed. For this purpose, it is very much superior to the show exhibit, which it is intended to displace.

The grading and conditioning services have worked at high pressure throughout most of the year, and the efficiency of this section has been maintained at a high level. Further reference will be made to these services later in this report.

For further information, reference should be made to the reports of the Senior Plant Breeder (Appendix VII), and the Senior Mycologist (Appendix V, in respect particularly of the Striga campaign).

Wheat.

Crop Year	Acreage Harvested	Production (bags 200 lb.)	Bags per acre	Quantity exported, calendar year
				Cwts
1926–1927	46,601	120,569	2.59	3,278
1927–1928	75,102	173,958	2.32	63,245
1928–1929	82,951	228,141	2.75	138,320
1929–1930	63,217	293,468	4.64	170,181
1930–1931	68,851	194,337	2.82	

The decline in production in the 1930-31 crop was due to the damp weather and the greater prevalence of rusts.

The general position with regard to wheat-breeding, which was outlined in last year's Report, is still very complex. Owing to the abnormal weather conditions, rusts were very prevalent during the year under review. Yellow rust was epidemic, and extended into altitudes below 6,000 feet. This is a very rare occurrence, and has only been recorded once before in this Colony. Stem rust was very prevalent, and destroyed many fields of Kenya Governor and Equator, while leaf rust was common, especially on Kenya Standard. The new wheat, Kenya Standard, is still resistant to stem rust, but is susceptible to yellow rust and leaf rust, and has proved itself not a very good yielder under the wet and adverse

conditions of this year. Work is therefore being continued at Njoro on the production of a wheat resistant to both stem rust and yellow rust, and a number of new lines are being tested.

Development of the " Njoro wheats " has also continued, and it is expected that a number of bags of seed of a variety strongly resistant to yellow rust will be available early in 1931. This wheat is not immune to yellow rust, but has shown itself very resistant in conditions where even Equator showed infection.

The breeding work at the Scott Agricultural Laboratories consists in endeavouring to evolve a quick-maturing wheat resistant to the stem and leaf rusts. Several plants have been selected which are immune to leaf rust, and very resistant to one of the physiological forms of stem rust. It is hoped thus to develop a strain resistant also to the other forms.

One of the most important features of the breeding work this year has been the discovery of a third physiological form of stem rust. When two American varieties, Kanrad and Reliance, which were imported recently, were tested at the Scott Agricultural Laboratories, they showed themselves resistant to the K1 and K2 forms, but when planted at Njoro they were infected with a form of stem rust which is believed to be a third physiological form and is now known as K3.

Experience with Kenya Standard this year has pointed to the advisability of not rushing new varieties of wheat on to the market without very exhaustive and severe tests, and it is felt that in future wheats should not be issued until experience of their behaviour has been obtained over several seasons. This will mean delay to the farmers, but it is hoped thereby that better and more permanent results will be obtained.

The introduction of wheat into the Native Reserves is making steady progress, and the benefit to the native in the addition of this crop to his diet is becoming more appreciated. It is replacing some of the millets hitherto grown in the higher altitudes, which were uncertain in their growth and low in yielding capacity.

Reference has been made in a previous section to the general depression in the world cereal markets, and to the steps taken to assist this section of the industry in conjunction with the maize industry.

Further information under this head is contained in the Appendices referred to at the close of the maize section.

Coffee.

The total area under coffee as at the 28th February, 1931, is returned at 96,689 acres, an increase of 6,484 acres over the figures for July, 1929. In 1930, 15,508 tons were exported, at a value of £1,477,586, representing 46.8 per cent of the total value of the agricultural exports of the Colony. The quantity of coffee produced from the 1930-31 crop, as shown in the Agricultural Census year, amounts to 250,919 cwt. clean coffee and 26,806 cwt. *mbuni*, a record output for the Colony, the previous highest (that of 1927-28) being 213,671 cwt. clean coffee and 32,621 cwt. *mbuni*.

The progress of the coffee industry has been constant from 1914 onwards.

Early in the year the 1930 crop was estimated at 16,000 tons, but owing to losses from pests and diseases, and to climatic and physiological causes, the actual crop was reduced to approximately 13,000 tons. Despite this fact, the average yield of coffee per acre is approximately 4 cwt., which is a good average when compared with other coffee-producing countries. Kenya coffee of attractive roast and liquor sold at a very considerable premium over the next best during the year. Early in the year, Kenya coffee was sold at Sh. 124 per cwt., but in July the average had fallen to Sh. 54. This price improved to Sh. 80 towards the end of the year.

In August, the new crop (1930-31) began to reach the London market, and was showing a marked improvement in size of bean, but could not be said to possess any outstanding merit as regards liquor. In October-November, the prices for Kenya coffee hardened, helped by the improved size and quality of the bean. The highest average price realized on a consignment was Sh. 129 per cwt., the bold size selling at Sh. 143 per cwt.

The heavy fall in price of all coffees was due to the fact that towards the end of 1929 the Brazil Valorization Scheme came to the end of its financial resources, and had to release coffee more freely, with the result that the market became glutted.

The high quality and reputation of Kenya coffee in the world's market is established. It has evolved special characteristics of liquor and appearance which cannot be produced in any other country. The fall in price of low-grade coffees will affect generally the prices of high-grade mild coffees, but if the quality of Kenya coffee is maintained it will always command a premium on the London market.

Coffee plantations throughout the country have experienced severe droughts and attacks from pests and diseases, resulting in considerable loss in crop, but means have been found to exercise a considerable measure of control over most pests and diseases known at present. There is no reason to suppose that any of these conditions will seriously affect further progress in the future.

Too much stress cannot be laid on the value of the systematic inspections of estates carried out by the Department, especially in the case of a crop like coffee, which is more susceptible to pests and diseases than any other plant industry in the Colony. The presence of a pest or disease is detected in its early stages, and planters are immediately advised of the most effective control measures. Inspections also provide a means for the collection of information on cultural problems.

Mealy-bug infestation in the past few years has cost the industry a considerable amount of money. This season the loss of crop due to mealy bug was comparatively small, as compared with previous years.

There is a marked decrease in the number of plantations infested with Stephanoderes and Sophronica, which may be attributed to the rigid control measures enforced by the Department. The white borer gave cause for considerable alarm in certain districts in 1929, and although the pest is located on a greater number of plantations, it has been kept well under control. It is necessary that inspections should be continued in the affected area, so as to enable the Department to take action where necessary.

The manurial experiments in connexion with mealy-bug infestation and coffee berry disease are being continued for two more years. Experimental work at the Scott Agricultural Laboratories has been continued in connexion with manuring, pruning, vegetative propagation, shading, seed selection and establishing varieties and types. The co-operative experiments with coffee-growers have been extended.

The Diseases of Plants Prevention (Coffee) Rules were revised and came into force in June. Provision was made in the new Rules for areas to be gazetted as " closed areas " for the purpose of preventing the spread of pests. Powers vested in the Department under the Rules had to be exercised in the

case of 63 coffee plantations, which were in a neglected condition. Eight cases under the Diseases of Plants Prevention (Coffee) Rules were taken into the courts and in each case a conviction was obtained.

Two meetings of the Coffee Consulting Committee were held during the year to consider questions affecting the industry. Meetings of the Coffee Planters' Union were attended by officers of the Department.

Much time was devoted to dealing with the fundamental points of the Coffee Industry Bill, which was submitted by the Attorney General to the Coffee Planters' Union and Coffee Consulting Committee for discussion. The Committee approved of the principles and provisions embodied in the draft Bill, and recommended that steps should be taken to introduce the Bill in Legislative Council.

[The Annual Report of the Senior Coffee Officer is omitted this year for considerations of economy. A typed copy will be sent, on application, to any one desirous of perusing it. The above summary, prepared by the Senior Coffee Officer, takes its place.]

Tea.

The area under tea as at the 28th February, 1931, was 10,052 acres, as compared with 5,593 acres at the 31st July, 1929, an increase of 4,459 acres.

930,209 lb. of "prepared" tea was produced during the year. Of this quantity, 160,384 lb., valued at £8,192 was exported.

Sisal.

The total area under sisal at 28th February, 1931, was returned at 137,299 acres, an increase of 27,924 acres over the figure given as at 31st July, 1929.

The area ready for cutting, i.e. over three years old, is given at 68,971 acres.

Exports of sisal fibre and tow increased from 312,954 cwt. in 1929 to 318,980 cwt. in 1930. The values of these exports amounted to £553,572 and £437,269 respectively.

The general world depression in agriculture affected the sisal industry severely towards the end of the year. The average price at which the fibre was sold in London during 1929 was £39-15-0 per ton. The price for January, 1930, was £35-15-0 per ton, and this fell steadily until by the end of

the year it had fallen to £21-10-0. In spite of reductions in costs of production and transport, a steady loss was being experienced at the end of the year of an average of about £3 on every ton sold in Europe. In these circumstances sisal estates were faced with great difficulties in carrying on their normal programmes of cutting, rotation and development. The economic unit used when sisal-growing first developed to any extent in this Colony was later found to be too small, and all that proportion of the profits which should normally have been put to reserve has been used in increasing the unit to an economic size. Thus estates found themselves without reserves to meet this period of loss.

Representations to Government were made by the sisal industry in the middle of the year, asking that some financial assistance be accorded it to tide over this depressed period. It was not considered by Government, however, that the industry was then in a position serious enough to justify State assistance. By the end of the year the position had become much more grave, and the inability of estates to carry on was threatening a serious reduction of present production and export, as well as of future production through the inability to maintain the rotation planting programme. (The position was again considered by Government early in 1931, but it was found possible to do no more than extend the facilities of the Agricultural Advances Ordinance, with its limited funds, to sisal growers, in common with all other agriculturalists.)

It will be remembered that the Agricultural Commission in 1929 in its Report raised the question as to whether some of the agricultural industries of the Colony had not reached the stage of development that calls for a research department supported by contributions from the industry, and in last year's Report it was noted that agreement had been reached whereby the industry was prepared to contribute towards the cost of special sisal services by means of a fund raised by a levy on sisal exports, to which fund Government should also contribute. This scheme was embodied in the Sisal Industry Bill, which has been under discussion for some time. The Bill provides for the fund to be devoted to investigations and research, the study of the economics of production, the improvement of machinery or plant for the production of fibre, the preparation and publication of statistics and reports relating to the industry and any other service calculated to promote the welfare of the industry or the more economic production of the fibre.

It will be noted that this Bill introduces a new principle in this Colony, and it is gratifying to be able to record the close agreement and co-operation between the sisal industry, as represented by the Sisal Growers' Association and this Department in designing its provisions. At the moment, owing to the depression, the introduction of the Bill is in abeyance, but it is confidently expected that it will come into operation on the recovery of the industry, and that it will have far-reaching results in benefiting the industry. The almost complete lack of investigational work on this industry in any part of the world renders it more necessary for this to be undertaken locally with as little delay as possible. Steps have been taken towards evolving a common scheme for work of the kind between Tanganyika and Kenya, embracing a field station in each country, with the fundamental research to be carried out under the leadership of, and largely by, the East African Agricultural Research Station at Amani.

Investigations by private interests continue into the engineering difficulty of obtaining 100 per cent extraction without injury to the fibre. These now promise to achieve success in the near future.

Sugar.

The area planted to sugar-cane on European holdings as at 28th February, 1931, was returned at 13,493 acres, an increase of 2,332 acres over that returned at 31st July, 1929. In addition, 9,120 acres were returned as planted on farms in the occupation of Indians, making a total for the Colony of 22,613 acres.

The output of crystallized sugar increased from 123,040 cwt. in 1929 to 181,820 cwt. in 1930.

15,683 cwt. of sugar, valued at £19,899 was exported in 1930, as compared with 15,643 cwt., valued at £25,503, in the previous year.

The sugar industry has not felt the general market depression to the extent of other crops, as the product is protected and mainly consumed locally or in the neighbouring territories. Local over-production, however, has arrived, and oversea markets have slumped. This has led the sugar interests of Kenya and Uganda to take steps to form an East African Sugar Association with the purpose of avoiding competition, fostering local trade, stimulating consumption, especially amongst the natives, and organizing the industry as a whole in order to effect the most economic management.

The measures taken by the Department for the purpose of eradicating " Mosaic " disease in the Nyanza Province were in force until June, and it had been hoped that the regulations could then have been withdrawn. In spite of the action taken, and the eradication of susceptible varieties of cane by many planters and natives, both voluntarily and after recourse to legal action, occasional rogues of these susceptible varieties were still to be found in certain blocks of cane, and it was considered advisable to continue the regulations for another year; that is to say, until June, 1931. Under these regulations no variety of sugar cane other than the Uba variety may be grown in the Kisumu–Londiani Administrative District. In anticipation of free planting again being allowed shortly, permission was given in certain cases to start nurseries of other varieties which are highly tolerant, in areas which had been free from mosaic for a considerable period. These canes had all been imported after a full period of quarantine, either in Uganda or South Africa, and had in addition remained in the quarantine at the Scott Agricultural Laboratories for over a year.

Coco-nuts.

The area of European-owned coco-nuts as at the 28th February, 1931, was returned at 8,499 acres, a decrease of 69 acres as compared with the previous year.

The export of copra shows a slight decline from 3,225 cwt., valued at £3,444, in 1929, to 3,120 cwt., valued at £2,886, in 1930.

An investigation into the cost of production of copra was carried out this year by the Agricultural Officer, Mombasa, assisted by a prominent producer. The figure arrived at under the best conditions of soil and management was £8 per ton, and the general average should be about £10 to £12 per ton. With copra on the London market quoted at £15-10-0 per ton, this means only a small margin of profit, and while these figures take no account of the value of any catch crops grown, it is necessary, in common with all the crops grown in this Colony, for economies to be effected, and a lower cost of production to be aimed at.

Wattle.

The area under wattle on European holdings as at 28th February, 1931, was returned at 11,702 acres, and the production of dried bark at 599 tons.

A considerable increase in the export of wattle bark is recorded, 131,160 cwt., valued at £44,680, being exported in 1930, as compared with 63,342 cwt., valued at £25,336, in the previous year. The export of wattle extract, however, declined from 21,777 cwt., valued at £28,310, in 1929, to 16,729 cwt., valued at £18,400, in 1930.

Rules were promulgated in June under the Crop Production and Live Stock Ordinance, 1926, and known as the Wattle Rules, 1930, to regulate the planting of wattle in the Colony. The main provisions state that *Acacia dealbata* (silver wattle) may not be grown, and that except for *Acacia decurrens* (black wattle) and *Acacia mollissima* (green wattle), no other varieties may be grown except for ornamental purposes. The object of these rules is to prevent the high-quality bark obtainable from black and green wattles from being mixed with the low-quality bark of silver wattle, and also to preserve the black and green wattles from deterioration through hybridization with silver wattle.

Further reference to this industry will be found in the section devoted to native agriculture.

Potatoes.

There was a considerable decline in the export of potatoes during the year, as shown in the following table :—

Year	1926	1927	1928	1929	1930
Quantity Exported ..	*Cwt.* 44,019	*Cwt.* 43,105	*Cwt.* 57,296	*Cwt.* 82,755	*Cwt.* 45,018
Value	£ 10,999	£ 10,036	£ 16,990	£ 27,050	£ 11,138

The periodic importation of new seed potatoes and of new varieties is one of the methods adopted by this Department to foster the industry. A consignment of ten varieties of seed was ordered from Scotland last year. These were received during March, and seed was planted at the Scott Agricultural Laboratories, at Njoro, and at two selected farms for trial and bulking. The crop from this planting was sold later in the year for further bulking by individual farmers.

The export trade from Kenya is almost entirely to the Bombay market, which is at present supplied largely from Europe. In order to compete with these supplies, the potatoes exported from here must be of good quality and even sample. It is therefore disappointing to note that not only was there a

decrease of 43 per cent in the quantity of potatoes received for grading, but the percentage of tubers rejected rose from 2.4 to 3.4 per cent, the crop not maintaining the standard of uniformity which was so marked last year.

As from the 1st of January, the British India Steam Navigation Company increased the freight on potatoes shipped from Mombasa to Bombay from Sh. 25 to Sh. 35 per ton. The matter was at once taken up by the Department, and, with the assistance of those engaged in the trade, representations were made which resulted in a reduction to Sh. 30 per ton, less the usual deferred rebate of 10 per cent.

Live Stock.

Native live stock is dealt with in certain respects under the title "Native Agriculture"; also in the report of the Chief Veterinary Officer.

Cattle.

The total number of cattle in the possession of Europeans was 236,895, an increase of 18,505 over the previous year.

The following table shows the numbers of live stock owned by Europeans during the last five years :—

	*1926	*1927	*1928	*1929	†1930
Cattle—Total	213,423	215,650	216,961	218,390	236,895
(*a*) Breeding Stock ..	105,556	107,434	110,796	115,777	135,530
(*b*) Oxen	107,867	108,213	106,165	102,613	101,365
Horses	1,844	2,137	2,172	2,288	2,263
Mules	780	719	709	632	492
Donkeys	931	1,046	1,238	1,235	951
Sheep (Wool-bearing) ..	162,848	172,299	176,261	210,912	218,845
Sheep (Native)	43,057	32,972	20,603	24,568	27,507
Goats	4,454	3,697	3,211	3,926	2,972
Pigs—					
(*a*) Breeding Sows ..	1,714	2,896	3,455	3,108	2,691
(*b*) All others	7,411	10,061	14,697	14,638	12,539
Poultry	35,728	43,988	38,845	35,786	49,183

* In respect of the census period 1st August to 31st July.
† In respect of the census period 1st March, 1930 to 28th February, 1931.

The above returns show a very satisfactory increase in the number of breeding stock. The continued decrease in the number of working oxen is noted. The increase in number of sheep is slight, and may be accounted for by the general adverse climatic conditions which prevailed during this period. Poultry also show an increase and there is evidence that greater interest is being maintained in cattle breeding and the improvement of herds.

This Colony continued to participate with the Empire Marketing Board in defraying the cost of shipping freight on pure-bred stock imported from Great Britain. On this service the contribution from this Government amounted to £253 in 1930.

Grants-in-aid were paid in respect of the importations of 15 bulls, 4 heifers and 4 sheep during the year.

The small number of female stock imported is to be regretted. In view of the high cost of importing bulls, it would appear desirable to establish as quickly as possible small pure-bred herds in this Colony, in order that pure-bred bulls of good quality should be available at a lower cost than the imported animal.

The maintained increase in production of dairy products tends to confirm the view expressed in the Report for last year, namely : " It is clear the best opportunity for European stockowners lies in the breeding of dairy cattle and the pursuit of a dairying industry." Kenya butter is rapidly establishing itself on the London market, and a steady expansion of this trade can be confidently expected.

There is an increasing demand for animal products in the native areas, and the native stockowner is being encouraged to meet this demand. Efforts continue to be directed towards creating an improvement in the preparation of hides for market and animal husbandry generally, as far as the resources of the Department permit.

It is to be regretted that the financial condition of the Colony did not permit of the operation of the Fencing of Farm Holdings and Cattle Cleansing Ordinances passed by Legislative Council in the year 1929.

The work at Government Farm, Naivasha, of the Rowett Research Institute, continues. During the year under review much time was necessarily spent in reconstruction, but by the

end of the year the farm was in full working and experimental work well under way. A report on this work is given in Appendix VIII.

Sheep.

The sheep industry passed through a difficult time in 1930. Cold, wet conditions prevailed throughout the main sheep areas, and losses were heavy. Wool values remained low, and the slow trade in fat wethers added to the difficulties. A decrease in quantity and value of wool exported has therefore to be recorded. The export of wool decreased from 9,135 cwt. in 1929 to 8,335 cwt. in 1930, and the value from £98,872 in 1929 to £70,615 in 1930. The industry has thus received a check from which it is hoped it will soon recover. The view is again expressed that the services of a technically trained officer, experienced in sheep management and the marketing of wool, are greatly needed and would be of invaluable assistance in developing the industry.

Pigs.

The local pig market continued to be saturated during 1930, and this fact is reflected in the decrease in breeding sows, namely 417, but even the reduced number of breeding sows is in excess of local requirements.

An improvement in the type of pig coming forward to the factories is noted, but until this can be said of the pigs surplus to local requirements, any attempts at developing an export bacon trade cannot achieve success. A small consignment of frozen pork was sent to England in December, which resulted in obtaining much information on the subject.

Hides and Skins.

Propaganda and demonstration work have been carried out by agricultural and veterinary officers in connexion with improvements in methods for the preparation of hides and skins for export along the lines outlined in the Report for last year.

A serious drop in market prices accounts for a decrease amounting to £156,613 in the export values of these commodities.

Regulations for the more effective control of the trade have been drawn up and are now under consideration.

Animal Products.

The following is a comparative table of the animal products sold by Europeans during the last five years :—

Year	Milk (Whole)	Cream	Butter-fat	Butter	Cheese	Ghee	Bacon and Hams	Wool
	Gallons	*Gallons*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
*1930	1,101,704	145,796	614,790	313,694	131,168	114,527	699,080	654,846
†1929	791,452	212,914	(*a*)	290,905	145,609	65,215	603,233	938,619
†1928	421,779	75,764	(*a*)	324,593	130,533	78,528	519,463	420,575
†1927	617,747	92,640	(*a*)	216,863	148,305	124,057	No return	632,088
†1926	395,031	72,693	(*a*)	291,894	144,070	115,815	430,119	670,752

* In respect of the census period 1st March, 1930 to 28th February, 1931.
† In respect of the census period 1st August to 31st July.
(*a*) Included in cream.

The increases in milk and its derivatives are noteworthy, and indicate that the very considerable expansion of the dairying industry, evinced in the previous year, has been fully maintained during the period under review.

The Live Stock Officer continues to devote his services to the promotion of the dairy and pig industries. Farm visits totalling 179 were paid by him, and practical help and advice on breeding and management of stock and production and marketing of farm and dairy products has been given. In addition, he addressed 533 letters, chiefly to inquirers seeking advice. The field work of this officer finds an important reflex in the improvement in quantity and quality of the animal products of the Colony.

Seven lectures were delivered during the year, and articles on the following subjects were published :—

Cream Production.
Pig Feeding.
Sheep-breeding in Kenya.
Buttermaking.
Ghee.
Cheesemaking.
Silage.

The second Stockowners' Conference was held in September, and a full report of the proceedings was printed and circulated.

[The Annual Report of the Live Stock Officer is omitted from the Appendices for purposes of economy. The information which it contains is largely given in this section of the report, prepared by the Live Stock Officer.]

Investigational Work with Live Stock.

Reference should be made to Appendix VIII, which contains a summary of the work carried out on the Government Farm at Naivasha by the Rowett Research Institute.

East African Stud Book.

One meeting of the East African Stud Book Committee, and two meetings of the sub-committee appointed to consider the revision of the horse section, were held during 1930.

Volume V will be published in July or August, 1931.

A sum of £133 was held in trust by the Royal Agricultural and Horticultural Society of Kenya, on account of the East African Stud Book, as at December 31st, 1930.

NATIVE AGRICULTURE.

Staff.

The number of officers devoted to this section during the year was eleven—four in the Kikuyu Province, four in the Nyanza Province, two in the Coast Province, and one at head office.

To supplement the work of these officers, 80 instructors and 54 labourers were employed by the Department, and 8 instructors and 30 labourers were employed by Local Native Councils. Of the 80 departmental instructors, five were employed for hide and skin demonstration work in Masai and Kisii, and of the eight Local Native Council instructors, four were employed as ploughing instructors in Central Kavirondo.

The instructors were distributed as follows :—

Nyanza Province (29) :

North and Central Kavirondo, 22; South Kavirondo, 7.

Kikuyu Province (33) :

South Kikuyu, 9; Fort Hall, 5; Embu, 9; South Nyeri, 4; Meru, 6.

Coast Province (23) :

Kilifi, 17; Malindi, 4; Mombasa, 1; Kwale, 1.

Masai Province (2) :

Narok, 2.

Meetings of Officers.

As noted in last year's Report, it was decided to hold staff meetings twice a year in Nairobi. As a consequence, meetings were held in January and August. A short course of instruction was arranged for officers at the Scott Agricultural Laboratories before the January meeting, when the scientific staff lectured and discussed the work then being done. At the conclusion of this course, the meeting was held in Nairobi, at which the Deputy Director and seven officers were present. Discussion was held on the following subjects :—

1930 World Agricultural Census.

Crops : Wattle growing; monthly grading report on quality of Reserve produce offered for export; demonstration plots.

Stock : Poultry-breeding pens; issues of cockerels, 1930.

General : Large-scale farming of land by Local Native Councils.

Report of Agricultural Commission.

The second half-yearly staff meeting was held in Nairobi in August, when the Acting Deputy Director and fourteen officers were present. The main subjects discussed fall under the following heads :—

Crops : Coffee-growing by natives (on this subject the meeting had the benefit of the experience of Mr. Jervis, Coffee Officer, of Tanganyika Territory, who was present in Nairobi and attended the meeting); introduction of crops of economic value; establishment of nurseries in Native Reserves for propagation of fruit trees; demonstration and seed-raising plots; seed issues; selection and storage of seed.

Marketing : Promulgation of rules under the Crop Production and Live Stock Ordinance, 1926, with reference to maize, simsim, potatoes and wattle.

Stock : Poultry issues; hides and skins.

Progress in Native Areas.

Except on the Coast, the main features of the weather during the year were very heavy long rains which injured crops by prolonging the growing period and causing waterlogged conditions in some places. Heavy downfalls occurred

during the short rains, but these were well distributed, and growing conditions were favourable in nearly all areas. The food shortage in parts of the Kikuyu and Ukamba Provinces which prevailed at the end of 1929 came to an end in February when produce from the 1929 short rain crops became available. Since then native food supplies have been abundant, except on the Coast where drought was experienced for more than half the year.

Agricultural progress in native areas during the year has proceeded steadily. It is not possible to separate export figures into native and non-native, but there is no doubt of a substantial decline in the value of native exports in 1930 owing to lower prices. The estimate of value is £400,000, as compared with £535,000 in 1929; the decline in price of hides and skins accounts for £129,000 of the total decrease of £135,000, so that, taking into account the considerably reduced price of other native export products, it is certain that, omitting hides and skins, there was a substantial increase in quantity of native exports in 1930. This is certainly the case with maize and wattle bark.

The number and variety of both foodstuffs and cash crops is improving, and the former is having a very beneficial influence on the health of the people.

Seeds issued in Native Reserves were as follows :—

FROM DEPARTMENTAL FUNDS AND SEED BULKING PLOTS.

Seed	Provinces									Total
	Coast	Kikuyu	Nyanza	Nzoia	N.F.P.	Ukamba	Rift Valley	Turkana	Masai	
Maize, White .. .. bags	..	110	587	190	..	2	..	..	60 lb.	889⅓
Maize, Yellow .. .. ,,	115	35	..	..	20	21	4	..	..	235
Wheat .. .. .. ,,	..	77	5	..	6	..	..	..	..	88
Rice .. .. ..loads of 60 lb.	..	..	12	..	..	..	..	..	..	12
Mtama .. .. ,,	..	..	..	..	10	..	..	..	..	10
Barley .. .. ,,	..	..	..	..	5	..	..	..	..	5
Pigeon Peas.. .. ,,	..	..	..	..	10	..	..	..	..	10
Buckwheat .. .. .. bags	..	116	..	..	..	..	..	..	..	116
Beans, C.W. .. .. ,,	55	67	3	30	10½	5	..	..	30 lb.	170½
Peas .. .. ,,	..	5	5	..	..	..	120 lb.	..	..	10½
Ground-nuts.. .. .. ,,	15	1	15½	..	80 lb.	..	..	..	..	32
Simsim .. .. .. ,,	96	1	..	..	60 lb.	..	..	..	..	97⅓
Potatoes .. .. .. ,,	..	4	..	10	..	..	..	..	..	14
Edible Canna .. .. tons	..	½	..	..	..	..	..	..	..	½
Millet .. .. .. lb.	..	..	..	..	140	..	..	..	..	140
Lucerne .. .. .. ,,	..	200	..	..	..	..	..	..	..	200
Cotton .. .. .. ,,	..	..	..	..	25	..	..	..	..	25
Castor Oil .. .. .. ,,	..	..	..	..	10	..	..	..	..	10
Black Wattle .. .. ,,	..	200	..	..	..	..	..	..	..	200
Vegetable .. .. .. ,,	..	22½	41½	6	3½	23½	..	..	..	97
Fruit Trees	..	..	2,295	6	..	..	..	..	..	2,301
Tobacco .. .. .. oz.	..	..	..	2	..	..	..	..	..	2

FROM LOCAL NATIVE COUNCIL FUNDS.

Seed	Provinces					Total
	Coast	Kikuyu	Nyanza	Rift Valley	Ukamba	
	Bags	*Bags*	*Bags*	*Bags*	*Bags*	*Bags*
Maize, White ..	..	..	237	30	4	271
Maize, Yellow..	220	..	..	..	20	240
Buckwheat ..	..	28	..	..	..	28
Wheat	..	6	..	..	..	6
Beans	..	10	45	..	10	65
Peas ..	..	..	10	..	..	10
Ground-nuts ..	..	..	15	..	2	17
Simsim	..	..	..	..	2	2
Potatoes ..	..	..	15	10	..	25
	Loads	*Loads*	*Loads*	*Loads*	*Loads*	*Loads*
Rice	..	..	..	..	8	8

Native diet is sadly lacking in vitamins, and an effort is being made to remedy this defect by encouraging the consumption of fruit. Fruit trees have been raised and distributed free of charge, and seed of tomatoes has also been supplied with this object in view.

For the first time in the history of Kenya, and probably of all African colonies, a census of native agricultural production in Native Reserves was taken, the results of which are given in the Agricultural Census for the year. In spite of the fact that it is difficult to obtain accurate information on native production and consumption of foodstuffs in these areas, it is believed that the results obtained present a fairly reliable record which will form a valuable basis on which to direct future progress.

It is realized that when the local domestic requirements of producers have been met, the economic handling of further output entails the provision of organized marketing facilities

The marketing of native produce has lately received consider able attention by the Department, and rules governing conditions of sale of maize, wattle, and simsim were promulgated in December under powers conferred by the Crop Production and Live Stock Ordinance, 1926. The reputation of the produce from native areas has been bad, and wholesale buyers for export have been reluctant to handle these supplies. Natives can grow produce of excellent quality, but middlemen continue to buy good and inferior quality produce at the same price. The bulking of bad produce with good results in the marketing of low-grade material. The marketing rules referred to above have been introduced with the object of improving this state of affairs in respect of the products mentioned. When staff is available for their administration, similar rules will be introduced for potatoes, of which there is now a fairly substantial export.

Experimental and seed-raising plots in the Kikuyu and Kavirondo Reserves and in the Coast Province have proved of value in providing larger quantities of seed available for distribution and in demonstrating better cultural methods and labour-saving devices, rotation of crops, manuring and selection of seed.

Instruction was given in the digging of manure-pits and the distribution of their contents on the land for the conservation of fertility.

The problem of the storage of grain is closely associated with that of marketing. Vermin and insect pests cause grave loss, and instruction in the building of better types of grain stores has been given. The benefits of selection and storage of seed separate from grain for sale have also been demonstrated.

Despite instruction by Agricultural Officers, but little progress has been made in the reduction of stalk borer, as natives will not restrict the planting season of maize and sorghum. The parasitic weed, Striga, is being checked in the Nyanza Province, and there is a decided improvement in its incidence, but the complete eradication of the weed will take years to accomplish, as seed is able to lie dormant in the ground for six years or more. Mealy bug still causes loss to yams and other crops in the Fort Hall and Embu districts.

In many parts of the Colony the prevention of soil erosion is work of primary importance; preventive measures have been taken in parts, and an officer appointed for the purpose by the Local Native Council, Baringo.

Three native agricultural shows were held during the year; two in the Coast Province, at Gotani and Lamu, and one in the Kikuyu Province, at Nyeri. There is no question of the value of these shows in arousing native interest in superior kinds of produce.

Local Native Councils assisted the Department in the maintenance of seed bulking and demonstration plots by the provision of funds. Seed of improved varieties is being issued progressively outward from centres, and in time inferior varieties should be eliminated to a large extent by this procedure.

Native Agricultural Exports.

The estimated values of agricultural exports of native origin for the last eight years are shown hereunder :—

NATIVE AGRICULTURAL EXPORTS

ESTIMATED VALUES OF AGRICULTURAL EXPORTS OF NATIVE ORIGIN FOR THE LAST EIGHT YEARS

	1923	1924	1925	1926	1927	1928	1929	1930
	£	£	£	£	£	£	£	£
Animals	10,000	20,000	16,000	11,000	12,000	11,000	10,300	8,600
Copra and Coconuts ..	10,280	35,000	28,000	20,600	12,000	23,000	2,500	2,250
Cotton	..	11,860	41,000	32,750	15,000	24,000	24,800	17,200
Cotton Seed	..	..	..	..	..	..	5,400	5,000
Ground-nuts	24,000	26,000	19,000	31,000	22,500	19,659	29,500	16,500
Maize	120,000	130,000	100,000	70,000	75,000	50,000	45,000	75,000
Millets	4,000	300	865	2,750	3,350	423	240	2,800
Pulse	12,000	15,000	16,000	20,400	19,900	13,000	12,500	14,000
Simsim	22,000	84,000	65,000	76,500	67,350	27,355	27,500	15,200
Hides	60,000	121,000	210,000	140,000	160,000	200,000	220,000	105,000
Skins	3,000	30,000	50,000	51,000	56,000	100,000	87,000	73,000
Oils—Simsim	2,400	2,200	3,000	5,500	3,550	5,000	10,000	6,700
Potatoes	3,000	4,000	4,000	7,250	7,500	7,000	24,000	10,500
Miscellaneous	1,000	1,000	1,000	2,000	2,600	2,000	2,000	2,000
Wattle Bark and Extract	..	..	..	..	..	..	35,000	42,000
TOTALS .. £	271,680	480,360	564,865	470,750	497,780	482,437	535,740	395,750

Native Live Stock.

An estimate of native live stock was made in 1930, with very much greater reliability than previously, and was as follows :—

	Cattle.	*Sheep.*	*Goats.*
In Native Reserves ...	4,742,000	2,805,000	4,036,000
The property of natives resident on European holdings	223,000	191,000	284,000
Totals ...	4,965,000	2,996,000	4,320,000

The possession of live stock continues to give social prestige, and after the few material wants of their owners are supplied, their possession is valued more than the cash obtained by sale.

Although a few grade bulls are to be seen in native areas, the improvement in quality of this stock is imperceptible. It is probable that this is due to a lack of appreciation of the value of better blood, and the risk of loss from disease when moved from one area to another. Some districts are overstocked, but the offer of animals for sale is generally of types unsuitable for the local meat markets. The proposed meat factory, to which reference was made in the last Annual Report, has not materialized as yet.

The fall in the price of ghee and failure of natives to accustom themselves to market fluctuations has retarded the output of this product, but the following figures of quantities and values of imports of this product show that consumption in the Colony is far in excess of present production :—

Importations of Ghee.

Year.	*Quantity.* Cwt.	*Value.* £
1928	8,986 ...	36,372
1929	8,910 ...	37,164
1930	6,553 ...	21,634

With the more extensive use of agricultural implements in the Nyanza Province, the use of draft oxen is being more fully realized by natives.

Hides and Skins.

Further attention has been given to the improvement of hides and skins, and Veterinary and Agricultural Officers have continued propaganda in their areas to this end. Shade-drying *bandas* have been put up at several points in South Kavirondo and in the Masai Reserve. An officer was posted for the greater part of the year in Masai especially for this work.

Proposals were under discussion for the introduction of rules under the Crop Production and Live Stock Ordinance, designed to improve the preparation of hides and to prevent certain abuses in the trade, as well as for the organization of marketing to ensure that a better price is paid for a better quality hide. It is expected that both these will be in operation early in 1931.

Native Poultry.

Native poultry throughout the Colony is of low standard. Eggs are small and the birds of poor quality for the table. The grading up by the distribution of Rhode Island cockerels has been in progress for several years, and a decided improvement is noticeable in several areas. During the year Local Native Councils provided funds for the purchase of 561 cockerels, and 69 were distributed free of charge from agricultural stations.

Kikuyu Province.

The short rains of 1929 extended the growing and ripening periods of nearly all September–October sown crops, and harvesting, which should have been finished in February, was not completed until the end of March. In consequence, the preparation of land for March planting was delayed. In addition, exceptionally heavy rains fell in March, April and May, and these unfavourable conditions reduced the output of foodstuffs to about 30 per cent below normal.

A shortage of food prevailed in the Meru area and in parts of the Embu district in January and February, but this came to an end when the 1929 short-rains crops were harvested in March.

The outstanding feature of the year in this Province was the increase in output of wattle bark. In the South Kikuyu district alone, the output rose to 6,170 tons in 1930 from 900 tons in 1929. At a time such as this, when prices have on the whole been lower than during the previous years,

wattle is a most useful reserve, as it can be allowed to stand, or be cut and turned into cash when required. Marketing rules were introduced for the sale of bark.

Although millets (foxtail and bulrush) and sorghums are still grown on a large scale, they are being superseded by maize. Natives are also realizing the great value of Canadian Wonder beans, compared with the many inferior varieties grown in the past. At higher elevations, field peas are becoming increasingly popular, and the acreage is extending, but the trade demand was small in 1930. On the other hand, although wheat is grown successfully at the same altitudes, natives are not taking up production to the extent anticipated. English potatoes were adversely affected by the heavy rain, which caused a high percentage of chats to ware. There is a necessity for the extended issue of fresh seed, as the original British Queen variety issued from the Kabete Farm is now heavily infected with virus disease. Seed is still being provided but in insufficient quantities. The famine of 1929 demonstrated the value of cassava as a reserve foodstuff in the lower and dryer parts of the Province, and nurseries were established at Embu and elsewhere for the provision of stocks for distribution. The people of the low-lying areas have been urged to extend the cultivation of this crop, and it is probable that it will reduce the severity of food shortage which may occur at any future date owing to lack of rain and invasion by locusts. Edible canna has been tried, with success, for the same purpose, and is being bulked and distributed. Irrigation has been practised in the Fort Hall, Embu and other parts of the Province for many years, but could be extended with advantage. There is a marked tendency for natives to concentrate their cultivation around the furrows, but the water is not always used economically. New furrows have been dug, and instruction given in admitting water to the crops.

Nairobi provides a good market for poultry produce and, subsequent to the distribution of cockerels of productive strains, improvement in quality of eggs and birds is noted.

Ghee depots have been operating with success in the Nyanza Province for several years, and efforts were made to establish them in the cattle areas of the Meru district. The value of ghee has been low, however, and but little progress has been possible.

A desire of the natives for the planting of forest trees has been encouraged, and, in addition to the acreage planted with wattle in other parts, over 32,000 seedlings were raised and

distributed in the Embu and South Nyeri districts alone. These plantings should be very beneficial for the provision of fuel and wind-breaks, and the prevention of erosion in future years. Fruit-tree seedlings have also been raised on a considerable scale, and instruction and assistance given in planting them.

While an extension in the use of implements is recorded in the south of the Province, where holdings are increasing in size, but little interest was awakened in the more northerly parts.

Nyanza Province.

The rainfall was early and extremely heavy in nearly all parts of the Province, and natives had the greatest difficulty in preparing their land for planting. Large areas in South Kavirondo were waterlogged in March and April, and planting was not completed until well into May. The output and quality of maize, groundnuts and other crops was reduced in consequence.

The price of maize in Kisumu fell to between Sh. 3 and Sh. 4 a bag, and had the Yala branch line not been operating much of the crop would have been left on the hands of the growers. The quality of the maize exported from these areas during recent years has improved very considerably, subsequent to the issue in bulk of seed of the white dent (known as Flat White to the trade) commonly grown by Europeans. Quantities of seed distributed in the Province during the year totalled 78,000 lb. In addition to the sum voted by the Local Native Council of North Kavirondo, Central Kavirondo provided £100 to assist in the purchase of seeds of main staple and other crops. Vegetable seeds were purchased in bulk and made up into small packets, of which 3,900 were distributed. Some 2,300 fruit trees and bushes were grown at Bukura and issued.

In South Kavirondo the maize and sorghum millet crops were below the average in yield, and total quantity, but the eleusine millet crop yielded well. Wheat declined in acreage owing to the fall in prices, though this crop does well in the Kisii Highlands. Bean crops yielded well, but groundnuts suffered from the heavy rains of March and April. The acreage under English potatoes is increasing, and this is becoming a popular crop. It yields fairly well, and the quality is good. Yields of sesame were good, but the low prices resulted in little selling and increased consumption by natives.

In North and Central Kavirondo, crops gave good yields in most of the locations, though those of the short rains suffered from drought. The surplus for sale was equal to that of normal years. The low prices prevailing restricted sales very considerably, especially those of groundnuts and simsim.

Field peas gained popularity in the higher locations, and may become a crop of considerable importance.

Beans and other pulses suffered from excessive rainfall during the early months and from drought later in the year.

Better methods of harvesting were encouraged, especially with maize. The chief fault is in storing damp grain, which becomes sour.

Trials were made with wheat, rye and English potatoes in the natives' own gardens. It is too early to say if these will be successful. As in other Provinces, the work of tree-planting has been given considerable attention. Natives increased plantings appreciably, but much remains to be done.

Grazing for cattle was satisfactory, and progress is being made with native dairying methods. The improvement of hides and skins by shade drying was continued, but prices were low and discouraged producers.

Marketing rules for groundnuts have had the desired effect of preventing the sale of immature and damp nuts, and the quality of samples brought to market has improved.

Prices realized for the cotton crop were very disappointing. Buying opened early in January at Cts. 13 per lb. of seed cotton at ginneries, and Cts. 12 at buying posts. Towards the end of the month, Cts. 15 and Cts. 13 respectively were paid, and these prices held for the remainder of the season. There was a record increase of 60 per cent in output in 1929, but dissatisfaction with prices that year resulted in a reduction of acreage in 1930, and only 954 bales of 400 lb. left the district, against 1,880 in the previous year. Despite the efforts of Agricultural and Administrative Officers, maintenance of output in the near future will be difficult.

The use of ploughs and other labour-saving devices is extending in this as in other Provinces, but the low prices received for produce retarded their purchase considerably. In spite of these circumstances, nearly 300 ploughs were bought by natives. This represents an increase of nearly 50 per cent

compared with 1929 and 200 per cent compared with 1928. The employment of four native ploughing instructors by the Local Native Council of Central Kavirondo shows that considerable interest is taken in the use of implements in this area.

Coast Province.

The rainfall from March to September was very inadequate, and long-rain plantings yielded poor crops. Good rains fell in November, and although less than normal, prospects of yields for short-rain plantings were fairly satisfactory.

Early-planted maize yielded a harvest, but later plantings failed. The heavy rains in the Highlands caused floods on the banks of the Sabaki River, and washed away much of the crop.

The Local Native Council, Kilifi District, and the Agricultural Department provided seed of yellow dent maize for an intensive planting campaign in the fertile Chonyi location, and planting was done under the supervision of the Agricultural Officer for the area, but unfortunately results were far from satisfactory owing to the drought from April to August.

Simsim (sesame) seed was issued in the Mambrui area, and satisfactory results obtained. Early-planted beans and small pulse are of great value in the Coast Province, and gave good yields in certain parts despite the rainfall.

Coco-nuts made remarkable recovery from the check caused by locusts in 1929. Towards the end of the year the effects of the drought reduced the output of copra. There is no appreciable output of copra from native plantations, and coco-nut wine is still the major product of native palms.

The output of seed cotton of all grades increased from 183,000 lb. in 1929 to 510,000 lb. in 1930. When unfavourable weather and low prices are considered, this is a very satisfactory increase. If prices regain their former levels, extended planting may be undertaken in the Sabaki River area, as marketing over the Sabaki River is made possible by the construction of a permanent bridge.

Road communications elsewhere improved considerably during the year. The construction of the Macupa Causeway has opened up the areas inland from Mombasa, and the construction of the bridge over the Sabaki River will improve transport conditions for the very productive area lying to the north.

[Considerations of economy render it necessary to omit from the Appendices the reports of Agricultural Officers which were given last year. The reports have been sifted for inclusion of the more important details in this section.]

Native Agricultural Schools.

Nairobi.

This school is situated at the Scott Agricultural Laboratories, Nairobi.

The advantages of the teaching of this school are more fully appreciated by natives than formerly, and the number of applicants for the course of training of three years was far in excess of vacancies at this school. At the end of the year there was a waiting list of seventy-seven natives desiring admission. Those under instruction were drawn from areas of the Colony as follows: Kiambu, 18; South Nyeri, 15; Fort Hall, 9; Embu, 8; Meru, 3; Ukamba, 4; Teita, 2; and Kamasia, 4.

In addition to elementary lectures on agricultural subjects, the maintenance of a school garden by each apprentice is a most important part of the training, and is a valuable means of ascertaining to what degree each apprentice is capable of putting into practice the instruction given.

A small holding of three acres was established at the school for the purpose of demonstrating the manner in which a native holding should be conducted to obtain the best results, and to show by means of accounts that the profits to be made compare favourably with salaries received by Native Agricultural Instructors and clerks. The land was divided into sections for the purpose of rotation crops, and the homestead was planned to accommodate cattle and to include a house for the occupant with the necessary outbuildings and stores. This holding has aroused considerable interest among natives in the Kikuyu Reserve.

New quarters were occupied by apprentices in January, and it is now possible to enforce cleanliness and discipline. This is having a very beneficial influence on the boys.

Bukura.

The number of apprentices under instruction was raised from thirty-six to forty-eight, and the housing was extended to accommodate this increase in numbers. Various improvements in bathing and sanitary arrangements were effected, and the health of the boys improved accordingly.

The training was mainly confined to field instruction.

Teachers from out-schools, headmen, and the local population generally were invited at regular intervals to see the agricultural methods adopted at the school, the use of labour-saving machinery, and the results obtained with crops new to the area. Of crops introduced during the year, field peas were most successful.

PUPILS AT NAIROBI AND BUKURA SCHOOL

	Number of pupils at		Number sent out trained	
	Nairobi	Bukura	Nairobi	Bukura
1923	21	..	..	..
1924	42	30	..	..
1925	43	32	10	..
1926	34	55	28	..
1927	42	45	..	9
1928	50	36	8	4
1929	48	32	24	20
1930	60	48	20	7

No pupils completed the course at Nairobi in 1927, owing to the extension of the course from two to three years.

The following table summarizes the nature of employment obtained by apprentices who have completed their course of instruction at the two schools :—

Nature of Employment	Nairobi						Bukura			
	1925	1926	1927	1928	1929	1930	1927	1928	1929	1930
Agricultural Department	8	14	..	7	14	10	..	..	7	4
Instructors, Local Native Councils..	..	..	..	..	..	..	9	..	8	..
Forest Department	..	..	..	..	2	2	..	..	..	..
Educational Work	..	3	..	..	2	4	..	2	..	..
European Farms	..	..	..	..	..	1	..	..	..	1
Other Work	..	11	..	..	..	..	..	2	..	1
Returned to Native Reserve ..	..	..	..	1	6	3	..	..	5	1

Field Experimental Work.

A large number of experiments was carried out at the Department's two experiment stations, the Scott Agricultural Laboratories and the Njoro Plant Breeding and Experiment

Station, as well as on private farms in co-operation with farmers in the Rift Valley and Nzoia Provinces. The results of the 1930 experiments were published in a bulletin early in 1931, and will therefore not be repeated in this report. Instead, a copy of the bulletin will accompany the report to all addresses outside the Colony on the mailing list. The bulletin has been distributed widely in the Colony. These do not include experiments on coffee, in regard to which it is hoped to publish a bulletin shortly.

The notes below on the Scott Agricultural Laboratories take the place of the usual annual report of the Agricultural Officer in charge, published previously as an Appendix. The annual report of the Senior Plant Breeder, covering the work on the Njoro Station, is retained as an Appendix to this report, but the sections devoted to the results of experimental work have been omitted.

Scott Agricultural Laboratories.

The year, reviewed as a whole, was exceptional for the heavy rains which fell throughout. In consequence, much damage was caused to crops, and several manurial experiments had to be abandoned.

It was, however, a very welcome year for the coffee section. Trees which showed signs of die-back after the heavy crop of 1929, made rapid recovery, and young trees planted out grew rapidly. This section was greatly enlarged during the year, areas being laid down to manurial experiments, special selections, etc. Work was carried out on budding, striking cuttings, etc.

The year proved one of the worst known for stem rust in wheat, and consequently a large number of the Plant Breeder's hybrid wheats were destroyed. A new pest, Katydid, appeared in the wheat crop just before it was piping, and caused considerable damage to the ears in the leaf-sheath. Very small yields per acre were obtained from the multiplication wheats during the long-rains season. The short rains, however, proved much more suitable, when all wheats made splendid growth, one multiplication wheat in particular yielding 9½ bags to the acre from a seeding of 37 lb. per acre.

The breeding of Muratha maize was continued, and a great improvement is to be noticed. A trial of Anveld maize was carried out, but it proved unsuitable.

Crop variety trials were continued, amongst the most promising being kudzu vine, edible canna, horse beans, fenugreek, Dixie soybeans, and pyrethrum. Owing to the heavy rains, the lucerne varieties gave six cuts during the year, and from some varieties heavy yields were obtained.

A large area of land was planted with field peas as a green manure during the short rains. Manurial experiments proving the value of fertilizers to the green manure crop were conducted.

Relative values of different compost manures, etc., were tested out in the form of a five-sided latin square during the short rains.

Poultry work has continued, and proved a valuable asset to the education of the native pupils.

Mules were introduced for field work for the first time, and proved invaluable.

An additional 27 acres of land were broken up, fenced and prepared for planting during the course of the year.

Njoro Plant Breeding and Experiment Station.

The report is contained in Appendix VII.

Specialist Services (Plant Industry).

As the reports are contained in the Appendices, the usual descriptions of the services are omitted here, for purposes of economy. These services are as follows :—

Agricultural Chemistry,
Entomology,
Mycology,
Plant Breeding,
Grassland Investigation.

Veterinary Division.

For the same reasons of economy, the report on the services of this Division is left entirely to the reports of the Chief Veterinary Officer and the Chief Veterinary Research Officer in the Appendices.

Grading and Inspection (Imports and Exports), also Grain Conditioning and Cool Stores Services.

During the year under review, record quantities of maize and wheat were exported. The percentage of wet and weevilly maize and wet wheat was abnormally high. These factors are reflected in the balance-sheets of the Grading and Inspection and Conditioning Services.

For the year ended June 30th, 1930, the Grading Service showed a credit balance of Sh. 25,682/31, while the Conditioning Service showed a balance of Sh. 55,127/52.

The grading account, since November, 1923, shows a credit balance to June 30th, 1930, of Sh. 104,568/95, and the conditioning account (which commenced work in November), 1925, has a credit balance to the same date of Sh. 59,217/88, or a total credit balance for the combined services of Sh. 163,786/83.

In view of the fact that a refund of four-fifths of the grading and conditioning charges in respect of the 1929-30 season's crop of maize and wheat has been made, balance-sheets and a statement of balances have been made up to the end of the year.

The grading account shows a credit balance to date of Sh. 136,487/90, and the conditioning account to the same period has a credit balance of Sh. 109,290/92, total credit balance of Sh. 245,778/82.

At the end of the year refund claims had been accepted totalling Sh. 299,979/39, and it is estimated that there are further outstanding claims totalling Sh. 1,443/44.

The balance standing to the credit of the combined services is, by virtue of refunds made and to be made, reduced to a debit balance of Sh. 55,644/01 (£2,782).

Plant Import Inspection.

16,625 packages of seeds, plants and fruits were passed, having a declared value of Sh. 351,714/77, and 100 packages, valued at Sh. 825/73, were passed in transit to Uganda.

As an illustration of the growth of this service, it is interesting to note that in 1926, 3,441 packages only were examined, the work over the period 1926 to 1930 having increased by 383 per cent.

Grading and Conditioning Services.

As foreshadowed in the Annual Report for 1929, an inland inspection service was inaugurated at the end of January, and was confined for the year under review to Kitale.

Maize.

1,702,520 bags of maize were graded during the year, an increase of 75.5 per cent on 1927, the previous highest record. The above figures include 228,480 bags of maize inspected at Kitale, but do not include figures for the re-inspection of this latter maize at the Coast.

Owing to the unfavourable climatic conditions that obtained throughout the Colony at harvesting time, and continued for the major part of the year, maize was received in a very wet condition, 28.6 per cent of the maize received being rejected for excessive moisture content. The large quantities of wet grain militated against the free movement of the crop for export, the season being very prolonged, which led to an increase in the incidence of weevil infestation, 7.02 per cent of the maize being rejected as weevilly.

Only 2,462 bags of native-grown maize were presented for grading, and it was all rejected as wet.

22,218 bags of yellow maize were inspected.

767,927 bags were graded "K 2."

Defective grain, due to pink ear rot, increased noticeably during the year, and was the main cause of maize being placed in the third grade.

The grain appeared to be less uniform in size and character than in the preceding year.

Shipments.—Four hundred and fifty-three export certificates were issued for 1,155,404 bags of maize; in addition, two inspection certificates were taken out for 1,469 bags of musty maize.

For the first time since the inception of the grading service, Kenya maize was exported to South America Gulf ports. Four shipments, comprising 223,248 bags of K2, were made.

Rule 25.—54,468 bags of maize were shipped to ports north of Beira and south of Port Said, without certificates.

Wheat.

118,632 bags of wheat were received at the Coast for grading, an increase of 236 per cent on the previous year's total of 35,502 bags. Owing to regrading at the Conditioning Plant after treatment, the actual total graded was 212,136 bags, an increase of 299 per cent over the quantity graded in 1929, namely 53,145 bags.

Equator wheat comprised 85.20 per cent of the wheat received.

96,908 bags were rejected as wet, being 81.68 per cent of the total received.

51.66 per cent of the wheat graded was placed in first grade.

Shipments.—Seventy-eight certificates for 112,761 bags of wheat were issued.

Rule 23.—As permitted by this rule, 992 bags of wheat were exported to local ports without examination or certificates being issued.

Maize and Wheat Conditioning Plant, Kilindini.

460,098 bags of maize and wheat were treated at the Conditioning Plant, comprised as follows :—

Maize—	
Wet	295,100 bags.
Weevilly	67,496 bags.
Wheat—	
Wet	97,502 bags.

Of the above, 5,734 bags of maize and 743 bags of wheat were accepted consigned direct to the plant.

In addition, 12,095 and 1,545 bags of maize were dried at the experimental drying plants at M'baraki and Kitale respectively.

Potatoes.

38,590 cwt. of potatoes were presented for grading, a decrease of 42 per cent on the previous year's total. The decrease is attributed to seasonal conditions, which proved unfavourable to the growth of the crop.

Beans.

One certificate for 112 bags of beans was issued.

Grading of Beans Rules have been promulgated under the Agricultural Produce Export Ordinance, with effect from January 1st, 1931. It is hoped to create a revival in the export of this crop.

Cool Stores.

The increased use made of the Government Cool Stores, as reported in the Annual Report for 1929, continued throughout the year. Especially worthy of note was the increase in dairy

products stored pending export. Butter and cheese showed very high percentage increases, viz. 308 per cent and 425 per cent respectively.

The following commodities were deposited :—

Fruit	193,547	lb.
Fr sh Fish	40,607	,,
Cured fish	7,871	,,
Cheese	21,200	,,
Offal	4,449	,,
Poultry	$34\frac{5}{6}$	dozen
Butter	9,401	ca-es
Beef	$324\frac{1}{2}$	quarters
Mutton and Pork	$325\frac{1}{2}$	carcass s
Eggs	807	dozen
Ham and Bacon	19,481	lb.
Vegetables	140	lb.
Milk	14	gallons
Yeast	125	lb.

[The annual report of the Chief Grader is omitted from the Appendices this year, owing to considerations of economy. The above summary, prepared by the Chief Grader, is given instead.]

Fisheries.

A further amendment was made to the Victoria Nyanza Fish Protection Rules, 1929, prohibiting trawling for fish. This was promulgated on the 7th August.

Further attention was given during the year to the recommendations contained in Dr. von Bonde's report, and provision was made in the Estimates for the year for the sum of £5,000 for expenses in connexion with further investigations. Owing to the fact that the Secretary of State for the Colonies was considering the institution of a Colonial Fishery Survey, and in view of the serious financial situation towards the end of the year, use was not made of this provision, and the whole question was postponed. It is hoped that when a Colonial Fishery Survey is made, the conditions in the Colony will be such as to allow Kenya to participate in this survey, when great benefit should accrue to the sea fishing industry on the Coast.

A scientific expedition, organized by Professor Stanley Gardiner, F.R.S., Professor of Zoology, Cambridge University, under the leadership of Dr. Worthington, and financed partly by the Royal Society, visited the Colony towards the end of the year to carry out research on the fish and other fauna of Lakes Rudolph and Baringo.

Locust Measures in 1930.

The anti-hopper operations, which were recommenced in November, 1929, were continued during January in the Northern Frontier Province, Embu, Kitui and Voi districts.

At the end of this campaign, only a few flying swarms remained in the Colony, and practically no damage was done to crops. During April, laying took place in Baringo and in Northern Turkana, but not on any extensive scale; in the former district, operations were carried out by one temporary locust officer during May and June, using the bran-bait method of destruction. In Turkana, operations were confined to the beating of hoppers by the local natives under the general supervision of administrative officers. The swarms that escaped all flew in a north-easterly direction, and by the middle of July the Colony could be regarded as free of the desert locust for the first time since March, 1928.

In July, the Senior Locust Control Officer proceeded to Northern Turkana, to carry out research work on the solitary form of the desert locust. He returned in November, and his report has been forwarded to the Imperial Institute of Entomology.

Agricultural Shows.

No agricultural shows have been held this year in the settled areas, but preparations are being made for a show to be held at Nairobi in January, 1931, and one later in the year at Eldoret.

Three shows have been held in native areas, on the 29th and 30th of August at Gotani, on the 13th September at Lamu, and on the 17th September at Nyeri. The first two were district shows, while the last was representative of the Kikuyu Province.

Labour.

The average number of men, women and children (almost entirely African) employed on holdings in the European areas for the last five years are shown in the following table :—

Year	Men	Women	Children	Casual Daily Labour	Total
*1930–1931 ..	89,856	3,387	19,393	7,574	120,210
1929–1930 ..	90,633	3,971	18,124	13,157	125,885
1928–1929 ..	85,082	4,249	15,304	6,062	110,697
1927–1928 ..	83,070	4,654	17,295	9,371	114,320
1926–1927 ..	76,838	4,802	15,428	5,006	102,074

*In respect of the Census Period 1st March, 1930, to 28th February, 1931.

A slight decrease of 5,675 in the average numbers of natives employed monthly on agricultural holdings is recorded.

The decrease is wholly due to reduced numbers of casual labourers having been employed during the period under review.

Comparatively few complaints relative to inadequacy of native labour supplies were recorded.

Publications.

The following reports, bulletins, etc., have been published during the year :—

Reports.

Annual Report of the Department for 1929.

Agricultural Census Report, 1929.

Report of Proceedings of Stockowners' Conference, September, 1930.

Crop Reports for the months of January, February, July to December.

Bulletins.

1. Preliminary Survey of some of the Soils of Kenya Colony, by D. S. Gracie, B.Sc. (Hons.), A.I.C., Assistant Agricultural Chemist.
2. Advice to Maize Growers, by G. J. L. Burton, M.C., B.A., Plant Breeder.
3. Preliminary Report on Crop Experiments, 1930.
4. Soil Deterioration in Kenya, by V. A. Beckley, M.C., M.A., A.I.C., Agricultural Chemist.
5. Summary of Report on Pasture Investigation in Kenya, 1926-1929, by H. Gunn, M.A., B.Sc., B.Sc. (Agric.), Rowett Research Institute.
6. Pig Feeding, by W. D. D. Jardine, B.Sc., N.D.D. (Hons.), Live Stock Officer.
7. The Kenya Coal Tar Ant Repellent—Kresotow, by V. A. Beckley, M.C., M.A., A.I.C., Agricultural Chemist.
8. Fermentation of Coffee, by V. A. Beckley, M.C., M.A., A.I.C., Agricultural Chemist.
9. A Note on Cream Production, by W. D. D. Jardine, B.Sc., N.D.D. (Hons.), Live Stock Officer.

10. Organic Manures, by V. A. Beckley, M.C., M.A., A.I.C., Agricultural Chemist.

Methods for the Biological Control of the Common Coffee Mealy Bug, by H. C. James, Ph.D., B.Sc., N.D.A., N.D.D., Assistant Entomologist.

Repellent Banding to Control the Ants attending the Common Coffee Mealy Bug, by H. C. James, Ph.D., B.Sc., N.D.A., N.D.D., Assistant Entomologist.

Veterinary.

Memorandum on Rinderpest Research in Kenya Colony by J. Walker, Chief Veterinary Research Officer (communicated to the 11th International Veterinary Congress).

Memorandum on Horse Sickness Immunization, by S. H. W. Whitworth, Veterinary Research Officer (communicated to the 11th International Veterinary Congress).

Aids to Stockowners (Revised Edition), by J. Walker, Chief Veterinary Research Officer.

General Leaflets.

Sheep Breeding in Kenya, by W. D. D. Jardine, B.Sc., N.D.D. (Hons.), Live Stock Officer (in Bulletin of the Imperial Institute, 1930).

Press Articles.

On the following subjects : Buttermaking, Cream Cheese, Devonshire Cream, Lucerne, Harvesting of Maize, Cultivation of the Black Wattle, The Madagascar Butter Bean.

AGRICULTURAL LEGISLATION.

The following Ordinances and Rules affecting the agricultural industry were promulgated during the year :—

Ordinances.

Food and Drugs (Adulteration) Ordinance, 1930. (The Sale of Coffee (Adulteration) Regulations, 1930.)
Sugar (Amendment) Ordinance, 1930.
Agricultural Advances Ordinance, 1930.
Chattels Transfer Ordinance, 1930.
Chattels Transfer (Amendment) Ordinance, 1930.
Wattle Bark Industry (Repeal) Ordinance, 1930.
Sale of Wheat Ordinance, 1930.
The Sale of Wheat (Agency) Rules, 1930.
Kerosene Oil (Repayment of Duty) Ordinance, 1930.
Diseases of Animals (Amendment) Ordinance, 1930.
Sale of Goods Ordinance, 1930.

Rules.

Under the Crop Production and Live Stock Ordinance, 1926—

The Maize (Marketing) Rules, 1930.

The Simsim (Marketing) Rules, 1930.

The Wattle Bark (Marketing) Rules, 1930.

The Wattle Rules, 1930.

Under the Cotton (Tax) Ordinance—

The Cotton (Tax) Rules, 1930.

Under the Diseases of Animals Ordinance—

The Diseases of Animals (Amendemnt) Rules, 1930.

The Diseases of Animals (Amendment) (No. 2) Rules, 1930.

The Diseases of Animals (Scale of Fees) Rules, 1930.

The Diseases of Animals (Dogs and Cats) Rules, 1930.

Under the Diseases of Plants Prevention Ordinance—

The Diseases of Plants Prevention Rules, 1930.

The Diseases of Plants Prevention (Coffee) Rules, 1930.

The Diseases of Plants Prevention (Coffee) (Amendment) Rules, 1930.

Departmental Reports.

The number of these reports in the Appendices has been considerably curtailed this year, and they consist only of the annual reports of the Veterinary Division, and of the specialist officers in the Plant Industry Division. The Appendices are as follows :—

I. Staff changes and new appointments in 1930.

II. Annual Report of the Chief Veterinary Officer.

III. Annual Report of the Chief Veterinary Research Officer.

IV. Annual Report of the Senior Entomologist.

V. Annual Report of the Senior Mycologist.

VI. Annual Report of the Senior Agricultural Chemist.

VII. Annual Report of the Senior Plant Breeder.

VIII. Summary of Report on Investigations in Animal Nutrition by the Rowett Research Institute.

IX. Summary of Meteorological Records.

Acknowledgments.

The thanks of the Department are due to the members of the many Consulting Committees who have assisted it in discussions, to the Board of Agriculture especially for its economic investigations, and to the Administrative Officers who by their assistance freely given have enabled steady progress to be maintained in the Native Reserves.

I desire to express my personal appreciation of the zealous efforts of the administrative and district field staffs, and of the excellent work and team spirit of the specialist officers on the staff, who have contributed so materially during a trying year to the assistance rendered to the agricultural community by the Department.

H. WOLFE,
Acting Director of Agriculture.

APPENDIX I.

Principal changes and new appointments in technical staff during 1930 :—

1.—Administrative and General.

Mr. E. Harrison, Deputy Director of Agriculture, was transferred to Tanganyika Territory as Director of Agriculture, on 11th September.

Mr. H. Wolfe, formerly Deputy Director of Agriculture, Tanganyika Territory, arrived on transfer to the post of Deputy Director (Plant Industry).

2.—Scott Agricultural Laboratories.

Mr. F. B. Notley, B.Sc. (Hons.), Entomologist, arrived on first appointment on 4th November.

Mr. C. A. Thorold, Mycologist, arrived on first appointment on 4th November.

Mr. D. C. Edwards, B.Sc. (Agric.), Agricultural Officer, arrived on transfer from Sierra Leone on 14th February.

3.—Division of Native Agriculture.

Mr. N. Humphrey, Agricultural Officer, arrived on first appointment on 26th February.

Mr. M. H. Grieve, B.Sc. (Agric.), Assistant Agricultural Officer, arrived on first appointment on 5th July.

Mr. C. D. Thornton, B.Sc. (Agric.), Temporary Assistant Agricultural Officer, appointed locally on 18th August.

4.—Coffee and Sisal Services.

Mr. C. D. Knight, Temporary Coffee Inspector, appointed locally on 6th January.

Mr. G. S. Powell, Temporary Coffee Inspector, appointed locally on 1st December.

5.—Grading and Inspection and Cool Stores Services.

Mr. C. L. Silvester, N.D.A., N.D.D., Acting Chief Grader and Inspector, appointed substantively on 1st January.

Mr. E. L. Bradford, Temporary Grader and Inspector, appointed locally on 6th January.

VETERINARY DIVISION.

Captain O. Dixon, M.C., M.R.C.V.S., appointed Acting Deputy Chief Veterinary Officer, on 14th February.

Mr. W. B. C. Danks, M.R.C.V.S., Veterinary Officer, transferred to Veterinary Research establishment on 1st August.

Mr. R. A. C. Campbell, Stock Inspector, died on the 18th December.

Division of Veterinary Research.

Mr. W. B. C. Danks, M.R.C.V.S., appointed Veterinary Research Officer on 1st August.

Mr. R. W. M. Mettam, M.Sc., M.R.C.V.S., Veterinary Research Officer, transferred to Uganda, 1st August.

Dr. S. H. Whitworth, B.V.Sc. (Melb.), D.V. (Zur.), M.R.C.V.S., proceeded on leave prior to transfer to Gold Coast, 1st November.

Dr. E. A. Lewis, M.Sc., Ph.D., Entomologist, arrived on first appointment on 9th May.

APPENDIX II.

ANNUAL REPORT OF THE CHIEF VETERINARY OFFICER

FOR THE YEAR 1930.

(*Note.*—The Annual Report of the Chief Veterinary Officer has been considerably curtailed in the interests of economy.)

The activities of the Veterinary Department during the year were directed mainly to the control of stock diseases.

It was, however, possible to devote a certain amount of attention to measures for improving stock by proper feeding, calf-rearing and general hygiene.

It has been usual for farmers in Kenya to devote their energies mainly to the production of one crop.

When markets are good, this method of farming may be quite sound from the point of view of the individual, but recent events have shown that in times of stress, it is better to have several interests on the farm.

The drought of 1929, together with the expenses due to locust invasion, did not improve the position of many farmers. In 1930, the rains were favourable and good crops were grown, but unfortunately there occurred a collapse of world prices, and in many cases it was difficult to sell any crop, except at a loss.

Many one-crop farmers are now in a serious position, because they have no alternative crop to fall back upon.

There are signs that many farmers, realizing that plant husbandry is not a present success, may take up cattle or sheep farming without giving sufficient consideration to the many problems to be dealt with in a stock farm. If good results are desired, it should be realized that the successful keeping of animals demands constant supervision and work.

There are, no doubt, many farmers who hesitate to take up stock-farming because of their fear of disease.

Sufficient knowledge exists of the most suitable means of controlling animal disease to justify a settler undertaking animal husbandry with confidence. If a farmer devotes sufficient attention to fencing, dipping and the control of movement of stock on to and through his farm, he should have little to fear from the more common and serious diseases of stock.

As mentioned before, this Department is investigating questions of breeding and feeding as affected by local conditions, and considerable help is being given by the Rowett Research Institute in the work at Naivasha.

Last year useful work was done at Ngong Veterinary Centre in demonstrating the results of keeping native cattle under good conditions. Housing, watering and milking are done on modern methods.

A careful check is kept on the milk records of the individual cows, and by this means it is possible to select the good milking cows from the herd as a whole.

That the results are good is admitted by all who have enquired into the working of the system and who have seen it in operation. The work is being continued this year on the same lines.

It is hoped as time goes on and different methods are tried and compared to make information on subjects available for public use.

It may come to be realized, however, that the future of the smaller farmer lies neither in growing plants nor growing stock alone, but in general mixed farming.

Stockowners' Conference.

Towards the latter part of the year a Stockowners' Conference was held, on the lines of the one held in 1928.

The present position of disease control, especially rinderpest, was fully considered, and the delegates were placed in possession of the state of vaccination as compared with double-inoculation. It was pointed out that although the incidence of this disease in settled areas is negligible, yet in the Colony as a whole it is unsatisfactory, and the complaints are made by neighbouring countries of the continuous presence of rinderpest on their borders. The discussion on East Coast fever centred on the importance of further study of tick life, and in particular the relation of the tick to local soil conditions. Other questions considered were those of insurance, movement of stock and points of general importance to the Dairying Industry.

For a more detailed account, reference should be made to the published report of the Stockowners' Conference.

There can be no doubt that such meetings of people interested in the various aspects of the stock industry are very helpful to the Department, and to the farmers of the Colony.

Squatter Stock.

The question of stock belonging to squatters on European farms is still undecided.

There is no doubt that the presence of cattle, sheep and goats, the property of natives working on farms, is the chief cause of the many outbreaks of rinderpest, bovine pleuro-pneumonia and East Coast fever.

The movement of squatter stock is supposed to be regulated by various agreements. In law this is so, but in practice no such control exists. There are a number of farmers who did not consider the question of any great importance, because they were chiefly concerned in growing some plant crop. The presence of native-owned animals on their land did not seem of a serious nature, and it was held that unless the squatters were allowed to keep stock even in excessive numbers, they would not remain and work. Many such farmers are now, however, turning to the keeping of stock of their own, and are beginning to realize that they will never be secure from disease, so long as squatters are allowed to keep stock, with the attendant movement to and from the neighbouring Reserves. As has been pointed out on previous occasions, the over-crowding of Native Reserves by stock is to some extent relieved by migration on to European farms, and Crown land. There can be no doubt that the time has arrived when a decision must be made and all such animals returned to and confined in the Reserves.

Cleansing of Cattle.

There is a growing tendency on the part of many settlers, especially in " Clean Areas " to build and use cattle dips.

Opinion, which in some cases was hostile when not indifferent, is beginning to turn in favour of any measures which may lead to the control of ticks and tick-borne diseases. Unfortunately, however, the supervision of privately owned dips is not a concern of Government, and as a result, there is no uniformity of procedure and no control of dipping.

A pamphlet has been published giving directions as to construction of dips and should be of general assistance. On account of the financial position of the country, it has been

found impossible to apply the provisions of the Fencing and Cattle Cleansing Ordinances. It is to be anticipated that when conditions improve, and when provision is made for a Land Bank, both Ordinances will be brought into force. They should prove of great value in controlling movement and in eliminating disease.

Diseases of Animals Ordinance.

A considerable amount of time has been spent in revision of the Rules made under this Ordinance. During the past twelve years so many alterations have been made in the older Rules that it was felt that the time had come for a comprehensive review of the situation.

The Principal Ordinance has been modified, making it compulsory for a resident native to notify the owner of the farm of the presence of disease amongst his stock. The rules governing the importation of animals from overseas have been completely remodelled and in particular authority is now given for the compulsory testing of cattle as to freedom from tuberculosis. Internal movement of stock in regard to native areas is now regulated so as to allow of greater ease in altering those restrictions which are still found necessary. Steps are being taken to extend the duration of " to and fro " permits to three months.

Surplus Stock.

A surplus of slaughter stock was again reported from stock farmers in the settled areas.

The local market does not seem able to absorb the available supply. The overstocking of Native Reserves gets steadily worse. No steps have as yet been taken to deal with what is admittedly a difficult situation. Government is, however, considering the means whereby the surplus may be reduced or eliminated, but it is premature to state what are these measures.

There is reason to believe, however, that the native is beginning to eat more meat. The evidence available suggests that in townships the preference is for grade meat or meat of fairly high quality. The complaint is often made that quarantine restrictions interfere with the supply of meat, keeping the price at a level unsuited to the native in the settled areas. There is nothing to support the idea, and most certainly the native in his Reserves has a practically unlimited supply. If they could be educated up to consume a greater quantity of flesh, especially goat flesh, it would be of great

help in reducing the stock, and also would be a means of increasing the present inadequate amount of protein in the food of the tribes mainly agricultural, such as the Kikuyu.

Game.

The difficulties following on unrestricted movement of wild game are still unsolved. That diseases such as rinderpest and several parasitic affections are common to game and domestic animals is well known, and until some definite system of segregation is evolved and enforced, the possibility of such diseases spreading by game must be remembered. The present position in regard to Game Reserves is not satisfactory inasmuch as their boundaries may be altered or quite abolished by a notice in the Official Gazette.

Cinema Work.

Some consideration has been given to the use of moving pictures in the education of the native as regards animal husbandry. A certain amount of propaganda work was undertaken in the North Kavirondo Reserve with successful results. It would appear that as the majority of natives are quite untouched by the ordinary educational facilities provided by Government, the cinematograph offers exceptional advantages of bringing new ideas to the native mind.

Native Agricultural Shows.

Two successful Native Agricultural Shows were held in the Coast Province, one at Gotani and the other at Lamu. A group of exhibits was staged by the Veterinary Department in each case, and comprised a model field dairy, demonstrations of properly prepared hides as compared with ordinary trade ones and specimens of ghee.

There is no doubt that such shows are of value in stimulating the imagination of the native.

Nairobi Agricultural Show.

Towards the latter part of the year a considerable amount of time was spent by members of the Veterinary Staff in making preparations for the Agricultural Show in Nairobi.

It was arranged to give demonstrations of the handling of native cows by natives under circumstances which could be copied by any cattle owner.

To this end a few open milking bails were erected in which the cows were milked. Four simple field dairies suitable for use in Native Reserves were erected and here the milk was separated and the cream made into butter.

Demonstrations were given in the feeding and general care of calves by the methods adopted at the Veterinary Training Centre, Ngong.

Three of these dairies were used as separating sheds and the fourth as a ghee kitchen where ghee was made daily.

A comprehensive exhibit dealing with poultry husbandry was staged, including small chicken runs, hatching boxes, a Colony run and a simple type of hen-house, suitable for use in Native Reserves, of a pattern described elsewhere in this report.

Interesting exhibits were shown of ghee made in the ordinary manner and that made under improved conditions. Hides were shown to display the effects of bad preparation, as compared with others correctly prepared and shade-dried. Pupils from Ngong gave demonstrations daily in the correct treatment of fresh hides.

An exhibit of ticks and poisonous plants attracted considerable attention, as did the specimens of diseased organs such as kidneys from cases of East Coast fever, lungs from bovine pleuro-pneumonia, etc.

Native Live Stock Statistics.

During the year an attempt was made to obtain more accurate statistics of native-owned live stock. In consequence, it is becoming evident that the number of animals owned by natives has been very much under-estimated. Most notable are the differences shown in cattle, goats, donkeys and camels, as shown in the following table :—

	1929	1930	*Increase*
Cattle ...	3,280,000	4,742,000	1,462,000
Goats ...	3,690,000	4,321,000	641,000
Donkeys ...	36,000	215,000	179,000
Camels ...	60,000	178,000	118,000

Importation of Live Stock.

In comparison with previous years, there was a marked decrease in the number of animals imported from overseas, cattle especially declining from 119 in 1929 to 56 in 1930. During the year, fifteen bulls, four heifers, four rams and two ewes were imported into the Colony under the Assisted Passages Scheme of the Empire Marketing Board. The cattle, with few exceptions, underwent immunization against redwater and anaplasmosis at the Nairobi Quarantine Station.

Permit System.

During the year the following changes took place in the personnel of the Honorary Permit Issuers :—

Remaining 31st December,	1929 ...	143
New Appointments	1930 ...	19
Resigned	1930 ...	6
Remaining 31st December,	1930 ...	156

I should like to express my thanks to those gentlemen who acted as Permit Issuers during the year; not only were Government officials relieved of a good deal of work by this assistance, but also the interests of trade were served by the greater ease in obtaining permission to move stock.

Branding of Stock.

During the year the following brands were issued or otherwise dealt with :—

" S " Brands Supplied	27
Renewal Brands Supplied	16
Brands Registered	77
Brands Transferred	4
Brands Cancelled	2

Export of Live Stock to Uganda.

An attempt was made to improve the conditions under which cattle are exported to Uganda for slaughter purposes. At present they go from Kisumu by steamer. It has been suggested that they might go through Tororo direct to Jinja. Up to the present it has not been possible to obtain the consent of the Uganda Government to any change. The numbers of stock so exported are as follows :—

	1928	1929	1930
Cattle	666	1,586	2,559
Sheep, etc. ...	433	782	1,544
Pigs	—	64	77

Diseases—General.

In the case of rinderpest, bovine pleuro-pneumonia and both types of lymphangitis affecting horses, a steady decline is noted over a period of several years.

On the other hand, although East Coast fever, black-quarter and foot and mouth disease have not altered to any marked extent in the same period, yet during the year under review an unexpected increase was recorded in these three

diseases, especially in the case of blackquarter, which rose from an average of eighteen for three years to ninety-three outbreaks during 1930. This may have been due to the exceptional rainfall in the affected areas.

Contagious abortion is demanding greater attention than in former years, chiefly on account of its relation to the dairying industry.

Tuberculosis does not cause much concern, and in view of the extra precautions now being taken to ensure that all cattle imported are free from this disease, it ought not to become the serious problem it is in some other countries.

SUMMARY OF OUTBREAKS OF DISEASE IN SETTLED AREAS DURING THE PAST FOUR YEARS

Disease	1927	1928	1929	1930
Rinderpest	73	83	66	34
East Coast Fever	31	37	32	33
Pleuro Pneumonia	20	8	4	3
Blackquarter	22	18	13	93
Trypanosomiasis	11	6	9	12
Foot and Mouth Disease	22	7	7	44
Horse Sickness	8	18	11	20
Ulcerative Lymphangitis	42	27	23	8
Epizootic Lymphangitis	7	7	3	3
Swine Fever	2	7	—	3
Contagious Bovine Abortion	1	9	5	8
Anthrax	27	43	20	23

The following particulars are furnished in respect of quarantines imposed and revoked during the year 1930 :—

QUARANTINES.

	Imposed.	Revoked.	Remaining.
East Coast Fever.			
Northern "Clean" Area	22	30	43
Molo "Clean" Area	3	1	13
Limuru "Clean" Area	*Nil*	2	3
Rinderpest	19	16	11
Trypanosomiasis	6	1	16
Rabies	*Nil*	*Nil*	1
Pleuro-pneumonia	5	3	12
Sheep Pox	1	*Nil*	1

Rinderpest.

There were only thirty-four outbreaks of rinderpest during the year in the settled areas.

This is the lowest figure recorded for five years, and there is every reason to believe that this would be still further reduced if the present movement of native stock could be controlled.

The use of vaccine and serum is now coming into favour, and offers a safer means of dealing with an outbreak among dairy cattle, inasmuch as the reaction is not attended by visible symptoms and does not cause abortion. Against this must be set the disadvantage that at present the immunity can be considered a safe one for about twelve months only.

The following tables give the total anti-rinderpest inoculations carried out durng the year :—

Area	Double inoculations	V.B. Tests	Serum Alone
Native Reserves and Veterinary Quarantine Stations.			
Machakos Quarantine Station ..	4,373	554	23
Kingwall and Baraton	8,733	520	
Alego	8,571	..	
Maseno	11,025	45	
Samia	3,957	..	
Sangalo (Kitai)	14,242	661	
Kibigori	6,086	1,036	
Nakuru—Naivasha	1,639	..	55
Settled Areas: By Rinderpest Service.			
Nakuru	1,414	..	
Nanyuki, etc...	16,345	..	
Trans Nzoia	2,757	13	
Nandi farms	4,372	3	
Chebororwa	3,944	8	
Elgeyo (Sergoit)	5,761	87	
Solai	1,075	..	
Uasin Gishu	19,275	773	
Settled Areas: By District Staff.			
Lumbwa	6,680	..	
Mombasa	100	..	
Nairobi	13,561	667	
Machakos	3,489	156	

Rinderpest is still prevalent in all Native Reserves with the exception of the Machakos Ukamba Reserve, from which no cases have been reported during the year.

The position is somewhat difficult as regard the reserves bordering on the adjoining territories of Tanganyika and Uganda. Owing mainly to a lack of staff it is impossible to undertake any comprehensive measures towards the control of this disease in these border areas. It is useless placing staff in one area with the intention of carrying out an extended programme of work when it is liable to be moved at any moment to another area to deal with an emergency.

In the Nairobi District, a certain proportion of these inoculations was done by means of anti-rinderpest serum and spleen pulp. The results were good, and all animals so treated were tested with virulent blood three weeks afterwards, without any breakdown. Outbreaks among dairy cattle were treated with serum and inactivated spleen vaccine, as a simultaneous inoculation. This was followed by vaccine only at the prescribed intervals. This procedure gives a method of dealing with an outbreak in a dairy herd, without the dangers attendant on double inoculation, and yet ensures an immunity for several months among both adults and calves. This treatment also was followed by good results.

Rinderpest Service.

It will be noted that this service was much more fully occupied than during the previous year.

The percentage of mortality among dipped stock has again fallen, this year reaching the low figure of 1 per cent. Among undipped stock, however, it was 2 per cent.

A larger number of susceptible cows were dealt with which had unweaned calves. The reduced milk supply consequent on double-inoculation occurred at the same time as the calves were reacting to the disease, and the combined effect was seen in the larger number of calves which died. On account of this mortality it was found desirable to increase the dose of anti-rinderpest serum. Although the average death rate is so small, cases do occur in which very serious results are experienced. In some of these cases it has been impossible to discover any cause to account for the mortality.

Tested virus makers from the Laboratory were again mainly used. In one "dirty" area, however, locally-obtained animals were used without any unfavourable results.

The following table gives the figures of inoculations carried out during the year :—

District	Double Inoculations	Calves	Tests with virulent blood
Uasin Gishu (Includes Marakwet and Elgeyo Native Reserves)	26,309	6,943	871
Trans Nzoia	2 005	752	13
Nakuru	1,311	1,178	
Nanyuki	9,179	7,166	
TOTALS	39,804	16,039	884
TOTALS FOR 1929 ..	22,706	13,350	1,416

Pleuro-pneumonia.

Three outbreaks only of this disease were reported during 1930, the lowest on record for several years. The most serious one was directly traceable to cattle moving from an infected native area on to an occupied farm.

In the East Suk Reserve a difficult position arose because Suk cattle from their Reserve moved out on to an extension of grazing which had been granted to the tribe, where they accidentally came into contact with the infected herds of the Samburu. The herd became infected and the whole-time services of a stock inspector were required to vaccinate and control the cattle concerned. 7,822 cattle were dealt with and in time the outbreak was overcome and the cattle were moved back to their own Reserve.

At present infection by pleuro-pneumonia seems negligible in settled areas, but it must be insisted that such a position can only be maintained by careful watching of native-owned cattle. Pleuro-pneumonia vaccine is still issued free by the Department. Any stockowner living under conditions of even slight risk of infection would do well to obtain vaccine and treat his cattle regularly. Of all diseases in Kenya, this is the most insidious and the most difficult to eradicate. In the Central Kavirondo Reserve no cases of this disease have been reported for a long time, and in the inspection of over 1,000 head of cattle slaughtered for human consumption no case was noticed.

East Coast fever.

During the year the Department had the advantage of the services of Dr. Cowdry, who was loaned by the Rockfeller Institute of America to carry out investigations into the

life-history of the parasite of East Coast fever. He was successful to such an extent as to make it very desirable that such specialist work be continued. This can only be done by a scientist trained and experienced in cytological work. I should like to record my appreciation of his work.

The following table gives the number of outbreaks in clean areas for several years :—

	1927	1928	1929	1930
Northern Clean Area	37	38	28	28
Molo Clean Area ...	3	12	6	4
Limuru Clean Area	4	1	—	1

Provisional quarantines were imposed on eight areas.

RETURNS FROM THE GOVERNMENT DIPPING STATIONS FOR THE LAST THREE YEARS.

STATIONS	EQUINES			CATTLE			SHEEP AND GOATS		
	1928	1929	1930	1928	1929	1930	1928	1929	1930
Nakuru ..	36	..	1	6,974	13,404	1,993	15,442	26,997	24,518
Gilgil	2	1	..	9,048	9,765	4,049	..	..	1,245
Isiolo	121	98	112	921	..	..	80,085	55,515	70,295
Nanyuki ..	..	2	18	19,278	25,947	25,681	..	..	..
Rumuruti ..	..	..	..	1,400	3,115	1,980	..	..	1,679
Eldoret ..	..	21	16	..	771	1,414	706	..	..
Naivasha ..	..	..	..	..	..	15,256	..	..	15,631

The provisions of the Cattle Cleansing Ordinance and the Fencing Ordinance have not yet been applied.

Foot and Mouth Disease.

This disease developed in an unusually serious manner in one of the settled areas—Nanyuki—where it assumed serious proportions. In Kenya it is ordinarily a mild disease, but in this case it caused a considerable mortality, especially among calves. An outbreak was recorded from the Nakuru district, where cattle which had had the disease three years before did not contract the disease, although subject to intimate contact with infected animals.

Trypanosomiasis.

This was diagnosed in some twelve cases. There does not seem any tendency to an extension of the areas actually infected.

In the Kavirondo Reserve a number of infected cattle were treated with antimony potassium tartrate with fairly successful results, but it was not found possible to continue treatment long enough or to observe the ultimate effect.

Rabies.

No further cases of this disease have been reported since the last Annual Report.

It is desired here to draw attention to an error which was made in that report. It was stated that the first authentic case of rabies could then be reported. Two or three cases were recorded in 1912–1913 in dogs which had been bitten by jackals. They were proved positive microscopically and by animal inoculation. There was no record of any person having been bitten.

Contagious Abortion.

Ten outbreaks of this disease were reported during the year, but it can be stated that only a very small proportion of cases are ever reported. In view of the growth of the dairy industry, the question of control of contagious abortion begins to assume a very serious aspect, not only from the reduction in number of calves, but also from the point of view of milk supplies. It is only with extreme difficulty that the causal organism can be distinguished from that responsible for undulant or relapsing fever in man. At one time it was believed that infection of human beings could not be derived from bovine sources, but of recent years evidence has been given that in some cases this does occur.

Dairy farmers are advised to have their herds tested for the presence or absence of this disease, and to consider whether the sacrifice of a few infected cows will not compensate for a succession of calves born dead. In highly developed countries where dairying is carried out on an extensive scale, it is probable that contagious abortion is a more serious economic problem than even tuberculosis.

Horse Sickness.

Twenty-nine cases of this disease were reported during the year.

Experimental vaccination was carried out at several centres throughout the country and many animals so treated were exposed to natural infection. It is too early yet to draw any conclusions as to the practical value of the vaccine. It has been found, however, that three vaccinations enable an animal to resist an inoculation with virulent blood.

Hæmorrhagic Septicæmia.

Several cases occurred in one district of a complaint similar to this disease.

Bi-polar organisms were constantly found in the films made from the blood of affected cattle.

The general symptoms are a swelling in the throat rapidly increasing in size, inability to feed and eventually death from asphyxia.

Nothing similar to this disease has yet been noted in Kenya, nor has true septicæmia hæmorrhagica been diagnosed.

Diseases of Sheep.

There was a very severe mortality among sheep during the year, traceable in many cases to the excessive rains and in some cases to internal parasites. So-called "Laikipia lung disease" caused heavy loss in some parts of the settled areas.

A disease, hitherto unknown, made its appearance in two or three centres in the Rift Valley. The symptoms in adult sheep are not very definite, although abortions occur, but in very young lambs there is a characteristic hepatitis, usually showing itself in the form of numerous white foci. In one case some 3,000 lambs died out of 3,800. In adults the mortality is from 5 to 10 per cent.

It is believed to be spread by some species of mosquito. There is therefore no reason to believe that the disease will spread very far.

Diseases of Pigs.

There were only three cases of swine fever reported during the year.

Several cases of tuberculosis were noticed.

A disease tentatively described as spirochætosis was reported from several districts. It is characterized by swelling of the glands and in many cases abscess formation. In a few cases lesions are found in the lungs and kidneys. In all cases noticed a small spirochæte was detected, but whether that is the causal organism or only a secondary invader is not yet clear.

The disease is most common under conditions of bad hygiene.

Several cases of measles were reported from one district.

ANALYSIS OF INOCULATIONS AND VACCINATIONS CARRIED OUT BY THE VETERINARY FIELD STAFF, 1930

STATION	Rinderpest Double Inoculations					Rinderpest Virulent Blood Tests	Rinderpest Vaccinations	Anti-Rinderpest Serum Alone Inoculations	Pleuro-pneumonia Vaccinations	East Coast Fever Tests	Mallein Tests	Tuberculosis Tests
	Adults			Calves								
	Native	Farm	Trade	Native	Farm	Trade						
Nairobi District	12,085	..	..	1,476	..	..	..	..	..	..	..	..
Naivasha-Gilgil	15	390	..	548	686	..	203	..	..	..	10	104
Lumbwa	..	4,770	..	1,910	1,910	..	..	55	..	..	..	..
Rinderpest Service	11,131	27,873	..	2,846	13,193	..	884	..	634	..	..	..
Nanyuki	..	Included in	Rinderpest	Service	..	..	..	..	..	..	..	..
Machakos Quarantine	1,061	1,396	1,558	62	224	72	554	236	..	58	..	..
Machakos Settled Area	2,812	563	..	36	78	..	..	..	23	192	840	..
Eldoret	..	Included in	Rinderpest	Service	..	..	..	156	6,589	..	..	..
Alego	6,199	..	..	2,372	..	..	..	..	42	..	..	..
Maseno	6,162	..	..	4,863	..	..	45	..	..	..	..	..
Samia	2,887	..	..	1,070	..	..	..	..	..	..	..	..
Kitai	3,993	..	..	1,616	..	..	..	..	..	..	..	..
Sangalo	8,261	..	..	372	..	..	661	..	15	..	..	..
Kibigori	3,673	..	..	2,413	..	..	1,036	..	..	..	..	..
East Suk and Baringo	..	..	..	..	..	..	..	..	663	..	..	..
Kingwal and Beraton	7,946	38	166	562	..	21	520	14	7,822	..	..	..
Mombasa	100	..	..	..	..	..	..	..	..	..	..	..
Isiolo	..	..	..	..	..	..	..	667	3,580	..	123	..
TOTAL	66,285	35,030	1,724	18,236	16,091	93	3,700	453	901	19,595	840	133	104

Live stock in Settled Areas.

The following figures are abstracted from the Agricultural Census of 1930.

Cattle.—The returns show a decrease of 5,063 in the number of oxen, due to their replacement by mechanized power. A noteworthy feature is that cows and heifers increased by 10,204 during the year, indicating prospects of future expansion in breeding and dairying.

Sheep.—The cold, wet season, caused a high rate in mortality of wooled sheep and as a consequence their numbers decreased by 3,675 or 1.7 per cent during the year. This is also reflected in the output of wool which decreased by 46,361 lb., equivalent to 4.93 per cent.

Pigs.—Although a decrease of 370 in the number of breeding sows is recorded, the number of "all others" remains stationary. The production of bacon and ham increased by 6.86 per cent during the year.

Horses, Mules and Donkeys.—There is a decrease of 23 horses and 84 mules recorded, while donkeys remain practically unchanged.

Poultry.—The returns of poultry show an increase of 9,058 or 25.3 per cent.

Live stock mortality.

The total deaths of live stock from all causes amounted to 53,049 head, of which 15,607 were cattle and 35,247 were sheep.

TABLE OF PERCENTAGE OF DEATHS OF LIVE STOCK

		%
Cattle	(*a*) East Coast Fever ..	4·78
	(*b*) Rinderpest	1·09
	(*c*) Other causes	23·55
		29·42
Horses		0·39
Mules		0·09
Donkeys		0·14
Sheep		66·44
Goats		1·02
Pigs		2·5

Note.—The mortality recorded under cattle, "other causes," was mainly due to tick-borne diseases, other than East Coast fever, and to internal parasites. The death rate of calves amounted to about 12 per cent.

The very high mortality shown against sheep (66.44 per cent) was mainly due to climatic causes and to internal parasites.

Hides and Skins.

Over the past five years more than half of the value of exports of native origin have been represented by hides and skins from Native Reserves—a value of £1,272,000 out of £2,304,700. The average hide or skin prepared in Kenya is not of first-class quality and attempts are being made to devise some system whereby the exported article may be made better (i) by licensing the dealer, (ii) by education of the native, or (iii) by grading the hides.

So far, little progress has been made in the latter two points. In Native Reserves, wherever possible, instruction is given by Departmental Officers in the preparation of hides and skins. Pupils at the various African Veterinary Training Centres are taught the best method of preparing shade-dried hides.

During the greater part of the year an officer toured the Masai Reserve collecting information on the trade position in hides and in demonstrating to the natives the best methods of preparing them. It would appear that a certain amount of success has been achieved, as several sheds for shade-drying have been erected by traders and others at various centres. Similar success was obtained in Central and North Kavirondo.

It is a general departmental instruction to all officers and native assistants that whenever and wherever possible, assistance and advice is to be given in these matters.

Slaughter Stock.

The stock slaughtered at the Nairobi abattoir during the last three years numbered :—

	1928	1929	1930
Cattle	12,107	12,154	11,615
Sheep and Goats	27,610	25,657	28,724
Pigs	1,139	1,412	1,479

Of these animals, the following numbers were condemned for various causes during 1930 :—

	No. of carcasses condemned	Weight of meat condemned
Cattle	1,072	605,254 lb.
Sheep and Goats	635	12,593 lb.
Pigs	7	2,494 lb.

Veterinary Quarantine Station, Nairobi.

During the year 37 bovines passed through the station, of which 18 were admitted in the latter months of 1929 and 19 were actually admitted during 1930, for immunization against redwater and anaplasmosis. The average period of detention was 191 days.

The following information, supplied by the Senior Veterinary Officer in charge of the district (Capt. J. T. C. Bradshaw), may prove of interest and value to workers in other countries.

	Days
A. Average period elapsing between first redwater and anaplasmosis inoculation and onset of reaction ... ... Maximum 59 days : minimum 22 days.	44.8
B. Average duration of reaction to anaplasma centrale ... ... Maximum 37 days : minimum 1 day.	14.9
C. Average period elapsing between second redwater and anaplasmosis inoculation and onset of redwater reaction ... Maximum 14 days : minimum 10 days.	11.4
D. Average duration of redwater reaction ... Maximum 30 days : minimum 1 day.	4.7
E. Average period elapsing between second redwater and anaplasmosis inoculation and onset of reaction to anaplasma marginale ... ... Maximum 60 days : minimum 28 days.	40.6
F. Average duration of reaction to anaplasma marginale ... ... Maximum 38 days : minimum 1 day.	13.4

One animal only died from a severe reaction to redwater combined with anaplasma marginale.

One animal gave a positive reaction to tuberculin and was slaughtered. The diagnosis was confirmed on post mortem.

Importations.

Cattle imported from overseas showed a marked decline in numbers as compared with preceding years, thus :—

1927	1928	1929	1930
130	82	119	56

Sheep show a slight increase over the previous year, 61 having been imported as compared with 58 in 1929.

The breeds of sheep were: Karakuls 12, Cheviots 3, Merinos 43, Romney Marsh 3.

The breeds of cattle included: *Bulls*—Afrikander 2, Friesland 16, Ayrshire 5, Shorthorn 21, Red Poll 10, Kerry 1, and *Heifers*—Shorthorn 1.

Tables are given as under, showing the movement of stock during the last three years:—

I.—Animals arrived from overseas and passed up-country:—

	1928	1929	1930
Horses	42	12	10
Donkeys	..	..	16
Cattle	80	119	56
Sheep and Goats	348	92	61
Pigs	25	15	3
Dogs	103	103	66
Cats	1	2	1
Rabbits	19	11	16
Mice	..	..	224

II—Coastwise traffic arriving on Mombasa Island:—

	1928	1929	1930
Donkeys	10	8	..
Mules	2	..	..
Cattle	5	138	..
Camels	1	12	..
Sheep and Goats	768	168	..
Dogs	..	7	..

III.—Stock arrived in Mombasa from up-country:—

	1928	1929	1930
Cattle	450	579	548

IV.—Stock arriving from the Mainland by road:—

	1928	1929	1930
Cattle	4,963	4,789	4,524
Sheep and Goats	22,733	23,894	24,014
Donkeys	69	42	40

V.—Stock slaughtered at Mombasa :—

	1928	1929	1930
Cattle	5,915	6,296	6,525
Sheep and Goats	18,988	19,043	21,094

Attention should be drawn to the fact that although large numbers of high-grade bullocks are available in Kenya for slaughter, no attempt has been made to create a market for that meat with the various shipping companies whose steamers use Kilindini harbour.

VI —Hides and Skins inspected for Export :—

	1928	1929	1930
Hides (bundles)	8,544	5,219	4,811
Skins (bundles)	3,184	2,912	1,959

(*A*) *Central Kavirondo.*

Two model field dairies have been built in the location of Seme by Government, and ten by veterinary scouts at the owners' charge. The average output of ghee is eight tins a month for each dairy. In Asembo two model field dairies have been built by Government, two by veterinary scouts at the owners' charge, and a large number by the owners themselves. The average output of these from this location is about five hundred tins a month.

In the Kibigori area a considerable amount of work in connexion with the supervision of ghee production in the adjoining part of the Reserve was done. At the native centres 18,870 lb. of ghee was produced. There is a complaint on the part of the natives that they are not given a fair price for their ghee. This may be the reason why the dairies in part of the Kano plains are now standing idle. At present only five separator houses are working, the output of each being about five tins of ghee a month.

(*B*) *North Kavirondo.*

A dairy was opened for the use of the natives near by, the cream being converted into ghee, which was sold at good market prices. The facilities provided were appreciated as is shown by the fact that the quantity of milk received for

separation rose from 3,300 lb. in September to 14,000 lb. in December, and the Local Native Council provided funds for the purchase of dairy utensils. The centre will be expanded and further development carried out next year within the limits of departmental votes.

African Veterinary Training Centres.

Ngong.

The development of this centre during 1929 was continued in the year under review.

A two years course of instruction has been arranged for the native pupils, by which it is hoped that those boys who are offered employment after training may be of real use to the stockowners or Government Departments who engage them, and in the case of boys who are given a chance to work on their own small shambas, they may act as a means of education to their fellow natives. A number of scouts, belonging to the Department and working at various veterinary stations, were attached to Ngong for a two months course of instruction. They were in due course returned and are proving of value in several of the instructional centres which are being started in various native areas.

At present there are twenty-six pupils, all of whom were chosen by the officers in charge of their districts.

The tribes represented are: Masai 7, Kavirondo 9, Nandi 4, Galla 2, Giriama 3, Kamba 1.

Attempts were made to recruit fifteen Masai and five Wakamba pupils, but the response was not good, as will be seen. Although this centre is within the Masai Reserve, it is apparently impossible to obtain sufficient suitable boys to take up the work.

Five Wakikuyu who had been pupils for several years and whose houses were not far distant were transferred from the establishment of pupils to form the nucleus of a permanent milking staff. This is a step of great value as it is essential to have the cows which are being tested on their milking capacity dealt with by expert workers.

An attempt is being made to secure pupils who can read and write fairly well before they go to Ngong, so that the time devoted to instruction in animal husbandry may not be frittered away in teaching the preliminary groundwork.

Several additional buildings and works were put up during the year, some to cope with the increase in cattle, especially calves, and others to ameliorate the living conditions of the native staff, pupils and labour.

An excellent small dairy has been constructed to serve as a type which could be built in Native Reserves. It is simply an eight-foot-square concrete floor with four corner uprights and a grass roof. The walls are of ordinary wire netting, and are closed when required by Kavirondo matting, which is rolled up when not in use.

It serves its purpose very well, is cheap, and is easily kept clean.

Several small plots were fenced in, and are being used to test out some of the local pasture plants.

Samples of natural pasture were taken and analysed for chemical constitution.

The result is shown as follows :—

Sample I Taken after a long period of dry weather		Sample II Taken two weeks after the beginning of the rains	
Dry matter	100	Dry matter	100
Nitrogen	3·99	Nitrogen	1·425
Acid soluble Ash	3·098	Acid soluble Ash	3·733
Lime CaO	0·672	Lime CaO	0·620
Soda Na_2O	0·177	Soda Na_2O	0·20
Potash K_2O	0·658	Potash K_2O	0·972
Phosphate P_2O_5	0·332	Phosphate P_2O_5	0·435
Chlorine Cl	0·208	Chlorine Cl	0·283

During the year the rainfall was exceptionally heavy, amounting to 44.21 inches, exceeding that of 1929 by 16.76 inches. Owing to this the grazing was excellent, and the condition of the cattle was good. There was no necessity to fall back on the reserve food which had been prepared in the form of ensilage and hay.

The practice of dipping all stock on the farm was continued, and at present it would seem that tick life has been practically eliminated. Nevertheless, owing to a case of East Coast fever in an ox from the Research Laboratory, it was decided to reduce the interval of dipping from seven days to five days.

Several of the local Masai showed a desire to dip their cattle, and it was arranged to allow them to use the farm dip. A fenced road of access was made from the main road adjoining to the dip and this is now used by them. For this service no fees are charged. It may be noted here that whereas the farm cattle which are regularly dipped show no deaths from East Coast fever, the loss among the neighbouring native-owned herds is very severe.

Disease among the stock.—Contagious abortion was again a source of anxiety. Several cases occurred and the cattle have all been tested; those showing three consecutive negative reactions were kept in one area. The infected cattle are now kept isolated some 1½ miles away from the others.

A few cases of colon bacillosis occurred among the calves, but the outbreak was checked by measures of inoculation and isolation.

One case of heartwater was noted, this was a Suffolk ram which died within two weeks of reaching Ngong from Isiolo.

A number of the cattle developed three-day sickness, only one cow died however. Two animals developed the disease a second time with a week's interval.

Stock.—During the year nineteen grade heifers were purchased to be used mainly for the instruction of pupils, as it has been found that is difficult for them to learn double-handed milking with native cows because of the small teats which these animals possess.

A beginning has been made with poultry husbandry; two pens each of Rhode Island Reds and Australorps have been purchased.

Milk and Milk Records.—Heifers not reaching a certain standard of milk production in their first lactation were originally cast. It has since been decided to give such animals a further trial, as it was thought that nervousness might

have been a cause in their poor milk production. In the majority of cases the trial has proved to have been worth while. Some figures are given below :—

No.	1st Lactation	2nd Lactation
31	No Milk	November 239 lb. December 547 lb.
5	No Milk	July 32 lb August 341 lb. September 324½lb. October 325 lb. November 383¼lb. December 294¼lb.
24	No Milk	March 447 lb. April 593¾lb. May 515¼lb. June 419½lb. July 446¼lb. August 319¾lb. September 277½lb. October 271¾lb November 94¼lb.

Other examples of milk yields are as follows:—

EXAMPLES OF MILK YIELDS

Number ..	15 MKS.	2 Boran	25 Boran	6 MKS.	70 Boran	98 Boran
Date of calving. 2nd lactation	17–9–29	3–2–30	10–10–30	17–4–30	1–5–30	12–4–30
Monthly yield in lb. ..	*lb.* September 175¼ October 429½ November 382 December 369½ January.. 292¼ February 260 March .. 200 April .. 152 May .. 96	*lb.* February 296¼ March .. 381¼ April .. 332½ May .. 304¼ June .. 268½ July .. 266½ August .. 220¼ September 179¼ ..	*lb.* October 402½ November 556½ December 531	*lb.* April .. 246¼ May .. 529¼ June .. 439½ July .. 420½ August .. 325 September 275½ October.. 258½ November 184½ December 217¼	*lb.* May .. 438¼ Juneé .. 374¾ July .. 374¾ August .. 312¼ September 280 October.. 291¼ November 252¼ December 253¼ ..	*lb.* April .. 343½ May .. 526 June .. 467¼ July .. 416½ August .. 343¼ September 252¼ October.. 246¾ .. ..
Total for Lactation or to date 31-12-30	2,356½	2,248¾	1,490	2,676¼	2,576¾	2,596½
Average per cent Butterfat	4·83	5·5	6·00	6·00	5·12	5·17

Feeding Experiments.

Cows.—During the early part of the year five cows balanced as to milk yield were kept in and fed on green lucerne and ensilage. Another group of five balanced cows received pasture and simsim cake while another five received pasture alone. The object of the experiment was to find the effect on milk yield and whether it was a sound proposition to keep cows indoors.

Unfortunately the five cows indoors had to be withdrawn at the end of two weeks owing to their refusal to eat and the consequent great drop in milk yield and condition.

The whole experiment was therefore abandoned.

Calves.—An experiment with bone meal and salt was undertaken with the object of determining the effect of growth and general health of calves with the following addition to their basal rations :—

(*a*) Bone meal plus salt; (*b*) salt.

Animals.—Nine calves (native) divided into three groups of three in each; the animals in each group being comparable as nearly as possible as regards—

(*a*) Aggregate weight.
(*b*) Health.
(*c*) Average age. The average age of the calves at the beginning of the experiment was 281 days.

Records kept.

Weight of calves at beginning of experiment and at fourteen days' intervals thereafter.

Measurements of calves at beginning of experiment and at sixty days' intervals thereafter. The measurements to be (*a*) girth, (*b*) height at shoulder and (*c*) length from point of shoulder to tail.

Food consumed daily by each group.

Basal ration.—Milk and concentrates (concentrates being two parts sim-sim, two parts maize meal, one part bran). All to graze during the day.

The concentrates were fed in boxes, 3 lb. being given to each group at a time.

The bone meal and salt were mixed in bulk and 4 oz. of the mixture given with each 3 lb. of concentrates.

For the salt group 4 oz. salt was mixed with every 3 lb. of concentrates.

The data gathered since the experiment started in May, 1930, is given below :—

AGGREGATE WEIGHT OF EXPERIMENTAL CALVES.

	Date															
	28–5–30	11–6–30	25–6–30	9–7–30	23–7–30	6–8–30	20–8–30	3–9–30	17–9–30	1–10–30	15–10–30	29–10–30	13–11–30	27–11–30	11–12–30	25–12–30
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
GROUP I.—Basal Ration Only	280	306	359	395	428	469	505	553	604	630	658	721	776	823	864	916
GROUP II.—Basal plus Bone Meal plus Salt	279	314	343	374	398	422	439	485½	572	559	591½	628	689	720	789	848
GROUP III.—Basal plus Salt	279	338	345½	385	422½	448	489	527½	577½	607	644	686	744	790	828	862

AGGREGATE MEASUREMENTS IN INCHES, EXPERIMENTAL CALVES.

	28–5–30			17–7–30			5–9–30			25–10–30			27–12–30		
	Height	Girth	Length	Height	Girth	Length	Height	Girth	Length	Height	Girth	Length	Height	Girth	Length
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
GROUP I.—Basal Ration only ..	83½	88½	56	96	99½	67½	104	114	72½	112½	125½	84½	118	139½	89
GROUP II.—Basal plus Bone Meal plus Salt	84	90	62	95	102	68	102	114	77½	110½	123½	80	119	137	85
GROUP III.—Basal plus Salt	82	87½	54½	95	102	67	104	114	71	114½	125	84	119	137	86

AMOUNT OF FOOD CONSUMED UP TO DATE .. .. GROUP I=162 lb. GROUP II=160 lb. GROUP III=153 lb.

SUMMARY OF EXPERIMENT UP TO DATE.

	Gain in Weight	Gain in Height	Girth	Length	Food Consumed
	lb.	*Inches*	*Inches*	*Inches*	*lb.*
GROUP I	635	34½	51	33	162
GROUP II..	569	35	47	23	160
GROUP III	583	37	49½	31½	153
This Represents per Pound of Food Consumed:—					
GROUP I	3·9	·21	·31	·200	
GROUP II	3·5	·21	·29	·14	
GROUP III	3·8	·24	·32	·20	

From this experiment, as far as it has gone, it would appear the Basal Ration cannot be improved by the addition of Bone Meal or Salt.

The experiment is still being carried out, however, and later results may alter the conclusions arrived at now.

It is realized that the number of animals dealt with in this experiment is not large enough to allow of definite conclusions being drawn, yet if the final results are favourable, it is intended to continue on the lines outlined above with a much larger number of cattle.

Ghee made at the centre was sold at various times during the year, at an average price of Sh. 48/50 a tin of 36 lb. In this way a sum of Sh. 3,186 was realized and credited to Government.

Crops.

Lucerne.—The original plot of lucerne is still giving a good yield, and some ten cuttings were taken from it during the year. The lucerne which was planted last year in another place did not do well and has been ploughed in.

Subterranean clover.—This has done very well. It has been found that although the plot which had been treated with superphospate of soda grew more quickly at first, the advance was not maintained, and now there is no apparent difference between the manured and unmanured plots. Cows have been grazed on this clover with good results, in some cases an increase in milk yield of 3 lb. per day being noted. It is said that when well established, this crop will kill out weeds; such has not proved the case at Ngong.

Maize.—Several acres of maize were planted and the crop grew very well. The maize when harvested was used for feeding poultry and cattle, and a quantity was reserved for seed.

Small plots were given to the various tribal groups of pupils, in order to demonstrate to them the advantage of using ordinary farm-yard manure. One half of each plot was manured, the other untreated.

During the year 6,719 head of cattle passed out of the Masai Reserve via Ngong for slaughter in Nairobi. It is proposed to open a slaughter house at Ngong itself some time early in next year. There has been a persistent demand for this and it should help in relieving the congestion at the Nairobi abattoirs, which are handicapped by inadequate facilities for feeding and accommodation of stock pending slaughter.

Machakos.

Further progress was made during the year in the construction of buildings required for experimental work, and for the accommodation of the staff.

A shed for milking was built of rough timber and thatched with grass. It provides standing space for twenty cows at a time.

Calf sheds were erected also of rough timber and with thatched roofs. The fronts are closed by wire netting only, to allow of free ingress of light and air. Each shed has twelve pens, six feet by four, to accommodate a calf each.

A 50 cwt. weighbridge has been installed by the station staff at a cost of Sh. 75.

A house of wood and iron has been built to act as a dairy. In it have been installed a cream separator of the Alfa-Laval type, and a churn, together with the other necessities for dairy work.

At present no accommodation is provided for the resident stock inspector other than a tent.

The difficult question of water has been overcome by a pipe-line, some 8,000 ft. long, connected with the water supply of the Machakos township.

The work of laying the pipe-line was carried out by the staff at the station.

Stock.—There are at present two bulls, sixty-one heifers, fifteen calves and thirty-three oxen at the station. All the stock are immune to rinderpest and East Coast fever. The dairy herd has been tested free of contagious abortion.

Milk records.—The records of some of the cows are given below :—

No. of Heifers	Date of Calving	No. of Days Milking	Total Yield in lbs.	Yield per day in lbs.
1	25- 8-30	128	745	5·82
10	10- 9-30	111	661¾	5 96
51	27- 9-30	96	279	2·90
54	29-10-30	64	146½	2·41
6	29-10-30	64	308½	4·81
53	15-11-30	46	281½	6·10
66	27-11-30	35	105	3
69	16-12-30	15	147½	9·13
61	24-12-30	8	16¾	2
64	26-12-30	6	18¼	3

Pupils and instructors.—At present there are no pupils, the routine work of milking and feeding, etc., being carried out by three permanent milking boys, assisted by the veterinary scouts. A course of instruction has been laid down, however, based on that in use at Ngong.

Baraton.

This is a new station situated in the Nandi Reserve.

Some 350 acres have been fenced in and two permanent buildings of concrete blocks have been erected—an office and a dairy.

A milking shed to accommodate eight cows, a calf shed for ten calves and a separate shed for calving cows have been made of rough timber with grass roofs. All this work has been done by the station staff.

A concrete cattle dip has been built by the Public Works Department and should be ready for use early in 1931.

Stock.—There are at present twenty oxen, two bulls, thirty-two cows and thirteen calves.

A beginning has been made with the hand-rearing of calves and the recording of milk production, but so far only records covering a few months are available. They indicate an average of 354 lb. of milk over fifty days' lactation, equal to some 7 lb. a day for each cow.

Maseno.

The area was part of a private sisal plantation and a considerable amount of work has been spent in clearing the land so that grazing areas might be made. Some 500 acres have now been enclosed in a wire fence, and 150 acres have been cleared of sisal. Fifty acres have been ploughed up and prepared for planting with grass when the rains break. Several plots of lucerne, maize, etc., have been planted.

A cattle dip is being built by the Public Works Department, and should be completed by the beginning of next year.

Quarters made of concrete blocks have been built for the native staff.

Stock.—The herd consists of two bulls, forty-two cows and twenty-eight oxen, all except the oxen being of the poor local breed. Much difficulty was experienced in obtaining the heifers as the natives are very unwilling to sell them. Of those which have already calved, many gave practically

no milk, and only two are of any note as regards quantity. There are at present six calves which are hand-fed, and although their milk ration is of necessity very small, they are thriving very well. All stock is grazed out at night.

Considerable progress has been made with a scheme for demonstrating poultry husbandry to the local natives. Three runs, enclosed with wire netting, have been erected, and two colony houses with grass roofs and concrete floors have been arranged for cockerels and pullets. Three demonstration native hen houses are now in use to accommodate the ordinary native hens used for hatching purposes. Large numbers of pure-bred chickens have been reared with natural brooders and some of the bigger ones issued to the natives for improvement of their own stock.

The demonstration poultry houses referred to above are designed from the points of view of cheapness, cleanliness, simplicity and protection against vermin. They consist of a wooden framework covered with wire netting, thatched with grass and raised above the ground on four uprights. The netting is continued under the roof grass and thus prevents the entrance of rats or wild cats, etc.

Isiolo.

Owing to the incidence of pleuro-pneumonia in the Isiolo area it was found necessary to vaccinate all cattle in the district. A total of 3,580 head was dealt with, and no cases of pleuro-pneumonia were reported among the cattle in the quarantine station. All the trade stock have been removed and the quarantine is now occupied only by Government cattle and a few head of slaughter stock.

A fairly heavy mortality among the cattle occurred as the result of an unusually virulent type of blackquarter followed by foot and mouth disease. The latter disease caused very many deaths among small sucking calves.

Several cases of trypanosomiasis occurred among the Government oxen, probably contracted when the animals were working further north in a tsetse fly area.

One hundred and twenty-three equines were tested for glanders on their passage south through the station; but no reactors were detected.

Sheep Breeding Experiments.—The sheep experiments began during 1929 and were continued, but owing to a combination of unfavourable circumstances, they were not successful, but the results are reported upon in order to indicate the difficulties encountered under adverse conditions.

The sheep were herded in the normal way during the day and at night went into a vermin-proof boma. Each representative flock was kept separate from the others, but all were subjected to conditions as near as possible identical. All sheep were dipped once a month, and were given anti-wireworm medicine once every three months. Although it is usual to dose only in the rainy season, yet so heavy was the infestation with internal parasites at Isiolo, that it was necessary to continue dosing irrespective of seasons. Wireworm was thus controlled, but heavy mortality was caused by other parasites causing debility. Licks of salt, sulphur, copper and iron sulphate were constantly provided; ordinary sheep management was practised in the service of ewes, and all flocks were vaccinated against anthrax, blue tongue and lung sickness. Much trouble was experienced with abortion, which was thought to be due to poisoning by some vegetable. The excessive rainfall, together with parasitic diseases, resulted in disaster to the ewes and lambs of the black-headed Persian breed. A similar fate befell the Gabbra flock. This is a breed suited to arid conditions and could not survive in such excessive humidity. A cross was made with a Suffolk ram and Masai ewes. The result was not a success under these conditions, because of " burr weed " becoming entangled in the long wool of the lambs, and also because of heartwater.

A cross between black-headed Persian rams and Masai ewes was met with no success, and the lambs were of no definite type or colour.

The flock of Samburu ewes was the most successful and proved capable of resisting both the rigours of the rainy season and the subsequent dry weather. The ewes were crossed with black-headed Persian rams. The lambs were similar to the Masai-black-headed Persian ones. It is considered that with proper control better results would be obtained within the breed of Samburu sheep itself. The principle of crossing two widely different and directly opposed types has little to recommend it.

In general, it became evident that Isiolo was not suited to wooled sheep or to sheep susceptible to heartwater; the high infestation by internal parasites seemed to show that it would be simpler to chose a centre more suited to sheep raising within the Northern Frontier Province.

It was in the long run decided to close the experiments and transfer the sheep elsewhere. Arrangements are now being made to begin sheep-breeding experiments with purely indigenous types.

Native Reserves.

Machakos.

Despite the very heavy rain during the year, the condition of the Reserve has not improved; it has in fact degenerated further, particularly in regard to water supply. Owing to large areas being denuded of grass, the erosion caused by the heavy rains must have been enormous.

The tendency towards increased cultivation continues to be marked, but as native methods of crop husbandry are very amateur, and when the crops do not appear abundant enough, usually after two years, the shamba is abandoned and a fresh one broken up; the net result is an increasing area of land being slowly but surely converted into semi-desert. It is regrettable that this condition of affairs is allowed to continue. No rinderpest was reported during the year; other diseases such as anthrax, blackquarter, foot and mouth disease, occurred from time to time, but it has been impossible to take any measures to control them.

Waterfalls quarantine station was closed on account of lack of support from the neighbouring natives. The veterinary officer of the district visited the Reserve on several occasions and offered facilities for immunization against rinderpest. The natives were unable to accept them because as they said they could not afford to pay.

Kitui.

The Reserve, with the exception of the four locations, near Kitui, is a " clean area " for East Coast fever.

A severe outbreak of rinderpest occurred in the southern and central parts of the Reserve, entailing a severe mortality. The origin of the outbreak was undoubtedly among the Machakos Akamba cattle grazing on the Yatta Plains. No inoculations were undertaken as the natives were unable to pay for them.

During the early part of the year stock was allowed to leave via Thika, Kibwezi and the northern end of the Reserve.

Owing to complaints from certain places that infected stock was being moved, a stock inspector was stationed at Kitui to inspect stock moving to Thika or Mombasa. Movement is now allowed to these places, in the case of the latter, via Kibwezi.

No steps have, as yet, been taken to deal with the problem of overstocking in this area.

Lumbwa.

There would seem to be no reasonable doubt that in this district the practically uncontrolled movement of native cattle from the Reserve to and across the adjoining alienated areas, and in the reverse direction, is the chief, if not the sole cause of the constant outbreaks of disease. Until this movement is checked, and in this the owners of land in the alienated areas could assist materially, there is no hope of stopping diseases such as rinderpest and bovine pleuro-pneumonia.

It is well known that both rinderpest and bovine pleuro-pneumonia are widespread in this Reserve, and several requests have been made by natives for assistance in controlling them. So far it has not been possible for much assistance to be given, although the district staff, when not occupied by work elsewhere, has done a little towards meeting the demands from the Reserves. It is hoped that provision may be made next year for a more or less permanent staff to be detailed to the area.

Northern Frontier Province.

Some progress can be reported as regards this area, the difficulties being due mainly to the prevalence of animal disease.

On account of the prevalence of bovine pleuro-pneumonia, there is no export of breeding cattle, and save for a small trade in slaughter cattle to the Coast and Zanzibar, there is no export in cattle otherwise. Owing to a severe outbreak of rinderpest, even this was prohibited for several months. Representations have been made to Government as the result of which a veterinary officer has been stationed at Isiolo to deal with stock questions in the Province. It is apparent that the first step towards any real scheme of development must be a stock survey to determine questions of disease, grazing and water. It would seem that there are possibilities of development in the ghee and hide industries; later, steps might be taken to dispose of stock by means of a factory on the Coast, dealing with the other animal products. There is a flourishing trade in sheep, about 100,000 being exported each year, mainly to the Kikuyu Province, and to the Coast.

Nandi.

During the year a stock inspector was resident in the Reserve at Kingwal quarantine station for the first few months, and thereafter at Baraton.

The following anti-rinderpest inoculations were carried out at the two stations :—

Adults 8,508 native cattle.
187 trade cattle.
38 farm cattle.

There were 520 virulent blood tests, and fourteen cattle were treated with rinderpest vaccine. These figures show a considerable increase on the figures for 1929.

The Veterinary Training Centre which was foreshadowed last year has now begun to take definite shape, and the progress made so far is recorded elsewhere.

Nyanza Province.

Samia.—Double inoculations during 1930 in neighbouring locations were :—

Adults 2,887, calves 1,070 (native cattle).

A number of cases of trypanosomiasis were treated with tartar emetic given intravenously, but owing to lack of staff and facilities, the work could not be continued.

Kisiani Dairy.—This dairy was erected by the Local Native Council, but is under the control of the Veterinary Department. During the year it dealt with 10,561 gallons of milk, purchased at 32 cents per gallon. The separated milk was returned to the milk supplier and the cream converted into ghee and sold on the market at good prices.

Masai Province.

Very little veterinary work was done in the Masai Reserve during 1930. Enquiries as to inoculations, and a more amenable attitude generally pointed to an awakening interest among the tribe.

On the whole the rains and the grazing were good.

Several hundred bovine pleuro-pneumonia vaccinations were carried out at Ngong. One herd in which the disease was existent was dealt with and the deaths ceased soon afterwards. This impressed the local natives to a great extent.

In June some 400 head of confiscated cattle were collected and quarantined at Loitokitok, afterwards being sold into Tanganyika. The Loitokitok area which had been free from rinderpest for some time prior to the sale, suffered from the

disease some little time afterwards. So far as can be ascertained, the disease is still simmering among the calves. A demonstration of rinderpest vaccination was given to the Masai during this outbreak. The cows and oxen at the local school were dealt with and, although in the centre of the infected area, no deaths occurred. Some of the oxen were used to drag dead cattle from infected bomas; this impressed the Masai greatly.

South Kavirondo, Masai, Suk-Turkhana, Kikuyu Province.

It was not possible to place staff in any of these Native Reserves. No veterinary work has, therefore, been carried out in these areas.

IMPORTS—ANIMAL PRODUCTS—THROUGH KILINDINI.

	1927		1928		1929		1930	
	Cwt.	Value	Cwt.	Value	Cwt.	Value	Cwt.	Value
		£		£		£		£
Ghee	10,475	46,832	8,896	36,372	8,910	37,164	6,553	21,634
Butter	67	738	145	1,617	153	1,565	41	46
Butter Substitute	344	1,721	524	2,601	511	2,420	381	1,751
Lard	102	656	143	893	207	1,262	109	685
Tinned Milk ..	9,309	30,303	11,998	38,353	14,018	40,310	13,246	31,839*
Bacon and Ham	122	1,237	99	901	60	710	114	398
Cheese	161	1,783	269	3,031	285	3,146	101	1,117
Tinned Meat ..	3,286	11,977	1,445	6,950	1,774	8,228	1,663	6,905
TOTALS ..	23,866	95,247	23,609	92,718	25,918	94,805	22,208	63,787

* Includes milk otherwise preserved.

EXPORTS OF ANIMAL PRODUCTS FOR PERIOD OF FOUR YEARS ENDED 31ST DECEMBER, 1930.

	1927		1928		1929		1930	
	Cwt.	Value	Cwt.	Value	Cwt.	Value	Cwt.	Value
		£		£		£		£
Ghee	116	786	121	1,004	534	4,478	793	4,929
Butter	507½	4,938	513	4,917	1,828	15,126	7,799	53,065
Butter Substitute	—	—	—	—	—	—	—	—
Lard	..	..	..	..	..	..	88	448
Tinned Milk ..	—	—	—	—	—	—	—	—
Bacon and Ham	157	1,515	224	1,789	338	1,991	1,311	6,318
Cheese	149	1,304	115½	523	142½	824	521	2,919
Tinned Meat ..	—	—	—	—	—	—	—	—
TOTALS ..	929½	8,543	973½	8,233	2,842½	22,419	10,512	67,679

H. H. BRASSEY EDWARDS,
Chief Veterinary Officer.

APPENDIX III.

ANNUAL REPORT OF THE CHIEF VETERINARY RESEARCH OFFICER FOR THE YEAR 1930.

Administration.

Staff.

Dr. E. A. Lewis, M.Sc., Ph.D., Entomologist, was appointed for the purpose of carrying out a tick survey of the Colony and arrived on first appointment on May 9th.

Dr. S. H. Whitworth, B.V.Sc. (Melb), D.V.M. (Zur.), M.R.C.V.S., was transferred to the Gold Coast with effect from December 31st.

Professor R. W. M. Mettam, M.Sc., M.R.C.V.S., Veterinary Research Officer, was transferred to Uganda with effect from July 30th.

Mr. W. B. C. Danks, B.Sc., M.R.C.V.S., was transferred from the post of Veterinary Officer to that of Veterinary Research Officer, with effect from August 1st.

Correspondence.

5,007 inward and 4,138 outward letters and telegrams were dealt with during the year, a total of 9,145, and an increase of 3,207 over the previous year. This does not include communications received and despatched in connexion with slides and specimens submitted for diagnosis. The number of slides and specimens received, registered and reported upon totalled 6,683, an increase over the previous year of 353.

Laboratory Farm.

The only crop grown during the year was green maize for ensilage.

The farm labour was employed generally during the year on the maintenance and upkeep of grazing lands, roads, fences etc., quarrying of stone for roads and buildings, and the usual transport work.

The number of calves born of the special breeding herd maintained at the Lower Farm was: heifer calves 39, bull calves 24, a total of 63.

Buildings and Plant.

Buildings.—The existing store, which was too small for present requirements, was extended by the addition of a new building 50 ft. by 30 ft. This was built of concrete blocks with an iron roof.

Work commenced on the erection of a hide-drying banda.

Certain buildings were erected at the Veterinary Quarantine Area, Nairobi, for the accommodation of cattle being rested from serum making.

The general maintenance, improvement and repair of existing buildings was carried out by the Laboratory workshops staff.

Plant and Apparatus.—New plant installed included a refrigerating and cold storage chamber, a stone crusher, and a steam centrifuge.

The steam, gas and electric plants were in continuous use throughout the year.

Water Supply.—This proved adequate throughout the year.

Fencing.—Further progress was made in the replacement of the old type of fencing by new iron standard fencing.

A gate and fencing was erected across the private road running through the Laboratory grounds for the purpose of excluding through public traffic.

Workshops.—The usual work was carried out in our own workshops, viz., repairs to transport vehicles, farm implements etc., and the manufacture of serum and other packing cases and various appliances for use in the Laboratory.

Finance.

Expenditure.—The amount originally sanctioned was £33,241, but additional expenditure was subsequently approved for the purpose of meeting extensive demands from the Uganda Government for anti-rinderpest serum. The actual amount spent was £36,432.

Revenue.—Revenue derived from the sale of Laboratory products amounted to £14,993. Of this amount £12,413 was in respect of sales to other East African Governments. In addition, anti-rinderpest serum issued to the field staff for inoculations totalled 202,675 doses. The value of this, at the scheduled rate of Sh. 2 per dose of 50 c.c. amounted to £20,267.

The sale of surplus live stock realized £552.

Live Stock.

Considerations of expense this year render it necessary to omit the detailed tables given in Annual Reports in the past. The summarized table, however, is retained and is given

below. This shows the number of live stock, other than small animals and poultry, dealt with during the year, including animals sent by and purchased from stockowners for experimental inoculations.

Species	On hand 1-1-1930	Increase	Decreases	On hand 31-12-1930
Horses	60	92	131	21
Mules	27	7	12	22
Cattle	1,238	1,461	1,422	1,277
Sheep	77	489	393	173
Goats	..	7	6	1
Pigs	53	86	112	27

In addition to above, some 126 cattle were purchased at outstations by the field staff for rinderpest virus production. There animals were taken on charge by the officers concerned, but the cost of purchase—approximately £282—was met from Laboratory votes.

During the year 808 Rhode Island Red cocks were received at the Laboratory for immunization against fowl typhoid (Kikuyu fowl disease) and fowl pox, prior to issue to Native Reserves.

This is an increase of 316 over the number dealt with during 1929.

Technical Routine.

The number of slides and specimens submitted for diagnosis totalled 6,683. These comprised :—

Bovines	6,157
Equines (horses)	109
„ (mules)	8
„ (donkeys)	6
Ovines	91
Caprines	5
Porcines	20
Canines	68
Avians (fowls)	102
„ (turkeys)	15
„ (ducks)	9
Camels	12
Various	81
Total	6,683

Laboratory Products.

The various Labortory products prepared and total quantity of each issued during the year are shown in tabulated form.

Blackquarter vaccine.—The preparation of blackquarter vaccine was discontinued in November, 1929, and recommenced in October, 1930. A number of cattle discontinued from laboratory experiments and rinderpest virus production, which are of little commercial value, being available, it was decided to utilize them in blackquarter vaccine production. The following method of preparation of the vaccine was substituted for the pure culture method, viz. susceptible cattle of about 18 months are inoculated intramuscularly with a lethal dose of virulent muscle and kept under close observation and destroyed *in extremis*. The muscles of the affected quarter are collected and passed through a meat mincer and normal saline mixed with the expressed juice and muscle pulp in the proportion of equal parts by volume. One to two hours later the mixture is strained through muslin and commercial formalin, 1 c.c to each 250 c.c. of the bulk, added. Toluol is then added to make 1 per cent of the total bulk. The thus treated extract is kept at room temperature in a dark room for twenty-one days and then tested on its virulency in sheep at doses of 5 c.c. and 10 c.c. respectively intramuscularly. If the virulency test sheep survive, the extract is centrifuged through a Sharples laboratory centrifuge and tested on its protective properties in sheep at a dose of 5 c.c. subcutaneously. The test sheep are tested on their immunity fourteen days later with a lethal dose of virulent muscle or pure culture injected intramuscularly, and if the test sheep show no marked local reaction and survive the test, the vaccine is issued for use at a dose of 5 c.c. subcutaneously for cattle.

Eight thousand one hundred and twenty doses of the Kabete prepared vaccine were issued. In addition to this quantity 39,420 doses of vaccine were obtained from Onderstepoort and used with satisfactory results.

The preparation of blackquarter vaccine has now become technical routine work and no difficulty is anticipated in maintaining supplies to meet demands.

PREPARATION OF LABORATORY PRODUCTS FOR THE YEAR ENDED DECEMBER 31ST, 1930

PRODUCTS	Balance on hand 31-12-1929	Prepared by the Laboratory during the year	Returned to the Laboratory	Used in Laboratory	Total Issues during the year	Issues to other countries	Written off as too old for issue	Balance on hand 31-12-1929
Anthrax Vaccine 1st and 2nd ..	Nil	11,585	2,180	..	11,585	200	2,180	Nil doses
Blackquarter Vaccine (Kabete) ..	,,	11,355	..	..	8,120	400	..	3,325 ,,
Blackquarter Vaccine (S. Africa) ..	,,	39,420	45	..	39,420	..	45	Nil ,,
Bluetongue Vaccine	9,298	79,355	5,715	75	38,035	..	4,218	52,040 ,,
Colon Bacillosis Vaccine	114	8,394	40	..	8,269	..	..	279 ,,
Contagious Abortion Vaccine ..	Nil	2,518	..	..	2,518	..	..	Nil ,,
Chicken-pox Vaccine	,,	4,527	..	745	3,782	300	..	,, ,,
Fowl Typhoid (K.F.D.) Vaccine ..	,,	14,934	..	832	14,102	545	..	,, ,,
Horse-Sickness Vaccine	,,	1,001	..	..	1,001	..	..	,, ,,
Laikipia Lung Disease Vaccine ..	,,	12,050	..	..	12,050	..	..	,, ,,
Pleuro-pneumonia Vaccine	,,	119,884	..	..	119,884	300	..	,, ,,
Paratyphoid Vaccine..	,,	3,400	..	..	3,400	..	..	,, ,,
Paratyphoid Expt. Feed Vaccine ..	,,	855	..	..	855	..	..	,, ,,
Redwater and Anaplasmosis Vaccine	,,	211	..	..	211	..	..	,, ,,
Rinderpest Vaccine	,,	35,045	..	..	35,045	300	..	,, ,,
Serum Anti-Rinderpest	12,550	462,160	16,425	65	465,245	261,125	2,165	23,660 ,,
Sheep-pox Vaccine	Nil	20,000	..	..	20,000	..	..	Nil ,,
Trypanblue—Bovine	,,	333	..	..	233	..	..	100 ,,
,, Canine	29	151	..	..	176	..	..	4 ,,
Wireworm Remedy Powder	190,000	990,700	..	..	894,600	31,000	..	286,100 ,,

RESEARCH.

EAST COAST FEVER.

By J. Walker.

The results of artificial immunization experiments previously carried out at Kabete are recorded in the Annual Reports of the Chief Veterinary Research Officer for the years 1924 to 1929 inclusive, which are embodied in the Annual Reports of the Department of Agriculture, Kenya Colony, for the corresponding years.

The work carried out is reviewed and the application of artificial immunization to the control and eradication of the disease, discussed in the paper entitled, " Artificial Immunization and Immunity in their Relation to the Control of East Coast fever " contributed by J. Walker and S. H. Whitworth to the Pan-African Veterinary Conference, Pretoria, August, 1929.

The material utilized for the Kabete experiments consisted of fresh spleen pulp and blood; a mixture of fresh spleen pulp and blood respectively, and collected from a beast usually in the later stages of the disease, occasionally lymphatic gland pulp was inoculated. Different methods of inoculation were investigated, viz. intrajugular, subcutaneous, intradermal, a combination of these, intrasplenic and intralymph gland, but whatever the method and material inoculated, a percentage of the cattle did not react as determined by temperature and smear examination, and the non-reactors were not protected against a severe reaction and death when exposed to natural infection.

It is the experience that the greater the percentage of reactions to inoculation, the greater the number of inoculated cattle which survive exposure, hence any successful method of artificial immunization should invariably produce a reaction with a negligible mortality.

The only known means of invariably transmitting East Coast fever, namely infestation with infective ticks, cannot be made use of owing to the high percentage of mortality resulting therefrom, but the possibility of conferring by some method other than inoculation of fresh spleen pulp and blood, sufficient resistance to protect against a severe reaction to tick infection was investigated. In this connexion, the value of the following was determined, viz :—

1. Extract of East Coast fever spleen.
2. Extract of East Coast fever blood.

3. Extract of East Coast fever spleen, and serum of East Coast fever immune cattle.

4. Extract of East Coast fever blood and serum of East Coast fever immune cattle.

5. Serum and blood of East Coast fever immune cattle.

The experiments and results obtained will be published in detail in a separate paper, a summary of which is now submitted.

1. Extract of East Coast Fever Spleen.

Previous experiments showed that pulped spleen of an East Coast fever beast, treated with normal saline and formalin and/or toluol, possesses no protective properties, and it was decided to determine the protective value, if any, of large doses of spleen, blood and liver rich in parasites treated so as to produce lysis of the parasites and cells and obtain an extract of these. Two methods of preparing the material were employed, viz :—

(*A*) Treatment of the pulp or blood with 0.4 c.c. of 9 per cent saline for each gramme of pulp; in the case of blood for each c.c. storage in the cold cabinet at 4° C. for 18 hours; addition of distilled water at the rate of 3.6 c.c. for each gramme of the pulp, or each c.c. of blood; addition of commercial formalin 1 c.c. to 800 c.c. of the bulk, storage in the cold chamber for varying periods 18–24 hours, and the extract then inoculated intramuscularly when large doses, and subcutaneously when small doses, were given.

(*B*) Treatment of the blood or pulp with distilled water at the rate of 1 c.c. of blood or 1 gramme of pulp to 3 c.c. of distilled water; storage for 18 hours in the cold cabinet at 4° C.; the liquid made isotonic by the addition of sodium chloride; addition of commercial formalin at the rate of 1 c.c. to 800 c.c. of the total bulk and storage for 18–24 hours in the cold cabinet; and the extract then inoculated intramuscularly or subcutaneously in the case of small doses. In both methods the blood was bled into potassium oxalate solution.

Method (*B*) produced better lysis of the red cells, leucocytes and disintegration of the Koch's bodies and gametocytes than method (*A*).

Summary.—Extract of spleen corresponding to 474, 474, 579 and 755 grammes of spleen pulp possessed no protective properties. The four cattle put in experiment when tested

on their immunity, contracted East Coast fever; two were destroyed *in extremis* for East Coast fever material and two died of the disease.

(2) Extract of East Coast Fever Blood.

Summary.—Three inoculations of extract of blood at intervals of several days, the total dosage corresponding to 1,375, 1,925 and 1,929 c.c. of cells, did not protect. The three cattle put in experiment, when tested on their immunity, contracted East Coast fever; two were destroyed *in extremis* for East Coast fever material, and the other died of the disease.

(3) Extract of East Coast Fever Spleen or Liver, and Serum of East Coast Fever Immune Cattle.

Summary.—A beast inoculated with spleen extract corresponding to 734 grammes of spleen pulp, and 130 c.c. of serum, and another beast treated with spleen extract corresponding to 2,200 grammes of spleen and 200 c.c. of serum, when tested on their immunity, died of East Coast fever. In both cases the serum was injected during the reaction to East Coast fever.

Nine cattle treated with spleen extract representing 20, 20, 25, 25, 674, 705, 1135, 911 and 1,340 grammes of spleen pulp respectively, and doses of serum varying from 100 c.c. to 500 c.c., reacted on immunity test and died of East Coast fever.

A beast treated with liver extract corresponding to 1,650 grammes of liver, and 200 c.c. of serum, when tested on its immunity died of East Coast fever.

(4) Extract of East Coast Fever Blood, and Serum of Immune Cattle.

Summary.—Inoculation of extract of blood representing 1,325, 1,500, 1,845, 2,055, 2,408, 2,575 and 2,845 c.c. of cells, and from 130 to 230 c.c. of serum of immune cattle, did not protect against a severe reaction, and death, to natural infection.

(5) Serum and Blood of East Coast Fever Immune Cattle.

Several head of immune cattle being available, the prophylactic and curative value of their serum was investigated. The serum producers were, prior to being bled for serum, kept exposed for several weeks in a highly infected camp, and in some cases, injected intramuscularly with large doses of blood rich in parasites with a view to increasing the potency of the serum.

Susceptible animals were injected with varying doses of serum prior to exposure to natural infection, at time of exposure, during the incubative period and during the reaction to East Coast fever. Other susceptibles were transfused at date of exposure with up to 900 c.c. of blood of the serum producers and in addition were given 500 c.c. of serum during the incubative period of the disease and during the reaction.

Summary.—Serum of immune cattle was found to possess no curative or prophylactic properties.

Transfusion of blood of immune cattle did not protect. Inactivated spleen, blood and liver respectively, serum and blood of immune cattle being of no assistance in protecting against a severe reaction, and death to natural infection, the possibility of invariably producing a reaction with fresh spleen pulp and blood by a modification of the methods of inoculation hitherto employed, is being investigated.

The experiments and results will be published in a separate paper.

Cattle which react to inoculation of fresh spleen pulp or blood of an East Coast fever beast are, in a percentage of cases, not completely protected against a reaction to natural infection, and to reinforce the immunity it is essential to expose them to natural infection.

In practice artificially immunized cattle would possibly in some instances not be exposed on a highly infected farm, in which case a percentage may escape infection, particularly when dipping is regularly carried out, and the immunity conferred by artificial immunization would not be reinforced. With a view to overcoming this, the possibility of successfully substituting (*a*) inoculation of emulsion of infective ticks (sp. *Rhip. appendiculatus*), or (*b*) infestation of the ears by hand with ticks (sp. *Rhip. appendiculatus*) of proved infective batches, for exposure to natural infection, was investigated.

(*A*) *Transmission of East Coast fever by inoculation of emulsions of fed and unfed nymphs respectively, which engorged as larvæ, or fed and unfed adults which engorged as nymphs, on an East Coast fever beast.*

In some instances the ticks were fed on an immune or susceptible beast for ninety hours; in other cases they were not fed prior to emulsifying.

The ticks were emulsified in a mortar with normal bovine serum, 1 c.c. to each tick. Various doses representing 5, 10, 20 and 30 ticks, were inoculated, usually subcutaneously at one site; in a few instances by a combined intrajugular, intradermal and subcutaneous injection.

The ticks utilized for the emulsions were from batches which were proved infective by infestation of the ears of susceptible cattle.

Sections of ticks of proved infective batches were microscopically examined for the presence of sporozoites in the salivary glands. The number of ticks sectioned varied; in cases where one tick showed sporozoites no further ticks of the batch were sectioned, otherwise up to a total of ten ticks were sectioned and examined. Of the fed ticks sporozoites were found in sections of ticks of the same batch which as emulsions transmitted East Coast fever; in other instances no sporozoites were observed in sections of ticks of the same batch which as emulsions transmitted East Coast fever. None of the unfed ticks varying from 2 to 10 which were sectioned and examined, showed sporozoites but emulsions of unfed ticks of the same batches produced East Coast fever in a percentage of cases.

Summary of transmission experiments with emulsions of ticks.

(1) Fed for 90 hours before emulsifying :—

Dose 5 c.c., representing 5 ticks.

Cattle in experiment, 4. Reacted, nil = 0%.
Non-reactors, 4 = 100%.

Dose 10 c.c., representing 10 ticks.

Cattle in experiment, 22. Reacted, 7 = 31%.
Non-reactors, 15 = 68%.

Of the 7 reactors, 7 = 100%, died of East Coast fever.

Dose 20 c.c., representing 20 ticks.

Cattle in experiment, 1. Reacted, nil = 0%.
Non-reactor, 1 = 100%.

Dose 30 c.c., representing 30 ticks.

Cattle in experiment, 7. Reacted, 2 = 28%.
Non-reactors, 5 = 71%.

Of the 2 reactors, both died of East Coast fever.

Immunity test of non-reactors.—Thirteen of the non-reactors have been tested to date on their immunity by exposure to natural infection or by infesting the ears with infective ticks. All reacted to East Coast fever, ten of which died of East Coast fever. The immunity test of the remainder of the non-reactors is not completed.

(2) Emulsions of unfed ticks of proved infective batches.

Dose 10 c.c., representing 10 ticks.

Cattle in experiment, 13. Reacted, 3 = 23%.
Non-reactors, 10 = 76%.

Of the 3 reactors 2 died of East Coast fever; the remaining one survived.

Immunity tests of non-reactors.—One has been tested to date on its immunity. The animal reacted and died of East Coast fever.

(*B*) *Transmission of East Coast fever by infestation of the ears with nymphs which engorged as larvæ, or adults which engorged as nymphs, on an East Coast fever beast.*

The ears of susceptible cattle were infested by hand with a varying number of ticks (10 to 175) of proved infective batches. After infestation, ear bags were fastened to the ears and the ticks after engorging and dropping collected from the ear bags and a count made of the number which engorged.

The following is a summary :—

Of 19 susceptible cattle infested with 10 ticks, 13 reacted = 68%. Non-reactors, 6 = 31%. 12 of the reactors died of East Coast fever. The 6 non-reactors were subsequently tested on their immunity by exposure to natural infection; all reacted and died of East Coast fever.

Of 8 susceptibles infested with from 12 to 20 ticks, 3 reacted = 37.5%. Non-reactors, 5 = 62.5%. The three reactors died of East Coast fever. Of 11 susceptibles infested with from 30 to 100 ticks, 11 reacted = 100%—10 of which died of East Coast fever.

Of 2 susceptbiles infested with from 100 to 175 ticks, 2 reacted = 100% and died of East Coast fever.

Conclusions.—Of the two methods investigated, as a substitute for exposure to natural infection for reinforcing the immunity conferred by artificial immunization, viz: (*a*) inoculation of emulsions of fed and unfed ticks, and (*b*)

infestation of the ears with ticks, in both cases of proved infective batches of *Rhip. appendiculatus*, the latter, viz. infestation of the ears with a large number of ticks, 50 and upwards, was found effective.

Further transmission experiments are indicated to determine whether emulsions of a larger number of *Rhip. appendiculatus*, 50 and upwards, of proved infective batches, will invariably produce a reaction to East Coast fever.

The Life Cycle of the Parasite of East Coast Fever in Ticks Transmitting the Disease.

During the last year, research work in connexion with East Coast fever at the Veterinary Research Laboratory, Kabete, has been directed towards immunization and the determination of the immunity conferred in naturally recovered and artificially immunized cattle.

The main obstacle operating against the introduction of a completely successful method of immunization has been the artificial transmission of the disease. Hitherto the only known way of artificially producing East Coast fever has been by the inoculation of spleen pulp or blood of an infected beast, but the comparatively recent discovery that transmission could variably be effected by inoculation of infected ticks opened up a new avenue. However, before this method could be put on a successful basis, it was essential that the infective stage of the parasite in the tick should be accurately determined.

This Colony was fortunate in obtaining the services of the eminent cytologist, Dr. E. V. Cowdry, Director of Medical Research, University of Washington, who was invited by the Government to investigate the life-cycle of the East Coast fever parasite in the tick host.

Dr. E. V. Cowdry, and his assistant, Dr. Arthur W. Ham, arrived at Kabete on the 9th May, 1930, and were occupied from the date of their arrival till the date of their departure. Dr. Cowdry left on 25th August, 1930, and Dr. Ham on 22nd July, 1930.

So that there would be no delay in the investigations, material consisting of the following was collected during the six months prior to their arrival by the Chief Veterinary Research Officer and his assistant, Mr. J. Forsyth, who very ably assisted, viz. : (1) Larval, nymphal and adult ticks (sp. *Rhip. appendiculatus*), containing a pure infection of

Th. parva; (2) larval, nymphal and adult ticks (sp. *Rhip. appendiculatus*) free of tick-borne diseases. Calves reared under tick-free conditions and infected with a pure infection of *Th. parva* and calves reared free of tick-borne diseases for controlling the infectivity and non-infectivity of various batches of East Coast fever infected and non-infected ticks, were also placed at their disposal.

Dr. Cowdry successfully traced the life-cycle of the parasite in the common transmitter of East Coast fever, viz. *Rhip. appendiculatus*, from the time infection is taken in during feeding up till the infective stage, and is continuing the investigations in America.

A preliminary note has been published by Drs. E. V. Cowdry and Arthur W. Ham in the October 31st, 1930, publication of *Science*, pages 461–462.

Observations on the Non-Transmission of Certain Protozoal Infections of Cattle through the Egg of *Rhipicephalus Appendiculatus*.

For the investigations into the life-cycle of *Theileria parva in the common tick host* (*Rhip. appendiculatus*) two sets of larvæ, nymphs and adult ticks were placed at Dr. Cowdry's disposal, viz :—

1. Larvæ, nymphs and adults free of protozoal tick-borne infections of cattle.
2. Larvæ, nymphs and adults containing a pure infection of *Theileria parva*.

The method of obtaining these was as follows :—

1. *Larvæ, nymphs and adults free from tick-borne diseases.*

Naturally attached adult females were collected just before repletion from a beast recovered from redwater, anaplasmosis, spirillum and *Th. mutans* infections, and which at the time was reacting to East Coast fever.

The larvæ, nymphs and adults of the first generation were fed on " clean " calves, i.e. calves born and reared under tick-free conditions. The calves were after infestation put on daily morning temperature until the termination of the incubative period of these infections. Smears were collected at intervals and examined.

2. *Larvæ, nymphs and adults containing a pure infection of* Th. parva.

A calf born and reared under tick-free conditions was infested with nymphs which as larvæ engorged on a " clean " calf reacting to East Coast fever naturally contracted. The former was infested during the reaction to East Coast fever wtih larvæ and nymphs free of tick-borne infections.

When it had been determined that larvæ, the progeny of the first generation of adult females which repleted on a recovered redwater, anaplasmosis, spirillum and *Th. mutans* beast did not transmit these infections the larvæ and nymphs of the first generation when nymphs and adults containing no tick-borne diseases were required, were fed on clean calves, and the calves kept under daily observation, temperatured and smears examined at intervals until after the termination of the incubative period of the above-mentioned tick-borne diseases.

As a result of these observations it was found that transmission of *Th. parva*, *P. bigeminum*, *Anaplasma marginale*, spirillum and *Th. mutans* infections does not occur through the egg of *Rhip. appendiculatus*.

Adult females (sp. *Rhip. appendiculatus*) were also collected from sheep and a mule, and the larvæ, nymphs and adults fed on clean calves.

It is the experience that sheep and mules in this Colony are recovered spirillum animals, and it is reasonable to assume that the sheep and mule were recovered spirillum animals. In any case no transmission occurred through the egg of adult females which repleted on sheep and a mule.

RINDERPEST.

By J. Walker.

In March, 1930, vaccination with inactivated spleen extract was gazetted as a service at a scheduled charge of Sh. 1 for a course of 3 doses.

The method consists of three 15 c.c. doses injected at seven days interval, each dose representing 3 grammes of spleen pulp. The three doses invariably produce a " block-out " reaction to a dose of fresh virulent blood or spleen virus inoculated a few days after the last dose.

Generally speaking, sufficient resistance exists up till about twelve months to protect cattle of average or low susceptibility against a severe reaction to contact or inoculation infection.

Owing to a demand from some owners for a method which would confer a more lasting immunity than the above and at a less cost than double-inoculation (serum-simultaneous method), the efficacy of a single dose of inactivated vaccine followed several days later by a dose of fresh virulent blood, or spleen virus, for conferring an active immunity, was investigated. The following entered into consideration in the planning of the experiment :—

(1) The spacing of the interval between injection of the vaccine and the dose of virus.

(2) Balancing the dose of vaccine with a view to obtaining an active immunity with a negligible mortality in 100 per cent of suspectibles.

One hundred cattle of average susceptibility, age approximately 12–15 months, were placed at disposal by an owner. The cattle were consecutively numbered and divided into lots; each lot was inoculated with a dose of a varying quantity of spleen pulp treated with commercial formalin, 1 in 1,000, followed at varying intervals with a dose of fresh virulent blood, used within four hours after bleeding, or a dose of spleen virus, the latter being used within thirty-six hours of despatch from the laboratory, or sixty hours after the death of the virus maker from which the spleen was collected. The spleen virus was despatched in bottles from the laboratory in an insulated box containing ice. The cattle put in experiment are to be submitted to an immunity test after the lapse of twelve months or thereabouts. The experiment was carried out in the field under the supervision of a veterinary research officer. The experimental inoculations and results obtained are summarized in the following tabulated form :—

RESUME OF EXPERIMENTS WITH VARYING DOSES OF INACTIVATED SPLEEN VACCINE, FOLLOWED AT VARYING INTERVALS BY A DOSE OF FRESH VIRULENT BLOOD OR SPLEEN VIRUS.

Number of Bovines	Dose of Vaccine Lot 206	Date Vaccinated	Interval between date of Vaccination and Virus Inoculation	Virus	Dose of Virus	Result			Remarks
						Reactors	Doubtful Reactors	Non-reactors	
5	15 c.c.	11-7-30	5 days	Vir. Bd. fresh	2 c.c.	*Per cent* 80	*Per cent* 20	*Per cent* Nil	No marked clinical symptoms.
5	5 c.c.	,,	8 ,,	Spleen virus	,,	80	20	,,	ditto.
15	10 c.c.	,,	8 ,,	,,	,,	33·3	20	46·6	ditto.
15	15 c.c.	,,	8 ,,	,,	,,	6·6	26·6	66·6	ditto.
10	5 c.c.	,,	12 ,,	Vir. Bd. fresh	,,	70	Nil	30	One of the reactors showed rinderpest symptoms.
10	10 c.c.	,,	12 ,,	,,	,,	60	40	Nil	ditto.
5	15 c.c.	,,	12 ,,	,,	,,	20	Nil	80	No marked clinical symptoms.
5	5 c.c.	,,	15 ,,	Spleen virus	,,	80	Nil	20	ditto.
15	10 c.c.	,,	15 ,,	,,	,,	33·3	33·3	33·3	ditto.
10	15 c.c.	,,	15 ,,	,,	15 c.c.	Nil	20	80	No symptoms.
5	15 c.c.	,,	15 ,,	,,	2 c.c.	,,	Nil	100	ditto.

A further lot of cattle of approximately fifteen months, considered to be of higher susceptibility, were divided into lots and each lot experimentally inoculated at the laboratory with a single dose of spleen pulp, varying in quantity, which had been treated with commercial formalin 1 in 1,000, and several days later the cattle were inoculated with a dose of fresh virulent blood used immediately after bleeding, or with spleen virus used seventy-two hours after the death of the virus maker, and stored at room temperature for forty-eight hours previous to inoculation in an insulated box containing ice.

The details of the experiment are summarized in the following tabulated form :—

Number of Bovines	Dose of Vaccine	Date Vaccinated	Interval between date of Vaccination and Virus Inoculation	Virus	Dose of Virus	Result			Remarks
						Reactors	Doubtful Reactors	Non-reactors	
						Per cent	*Per cent*	*Per cent*	
3	5 c.c.	7-3-31	8 days	Vir. Bd. fresh	2 c.c.	33	0	66·6	No clinical symptoms.
3	5 c.c.	,,	,,	Spleen virus	,,	33	0	66·6	ditto.
2	15 c.c.	,,	,,	Vir. Bd. fresh	,,	50	0	50	ditto.
2	15 c.c.	,,	,,	Spleen virus	,,	0	50	50	ditto.
2	30 c.c.	,,	,,	Vir. Bd. fresh	,,	0	0	100	No symptoms.
2	30 c.c.	,,	,,	Spleen virus	,,	0	0	100	ditto.
3	30 c.c.	,,	,,	,,	15 c.c.	0	0	100	ditto.

Conclusions.

(1) A single dose of spleen vaccine treated with commercial formalin 1 to 1,000, followed at varying intervals by a dose of fresh virulent blood or spleen pulp virus, produces a varying percentage of temperature reactions with little or no clinical symptoms. A percentage of susceptibles do not react, as determined by temperature reactions.

(2) It would be unsafe to brand doubtful and non-reactors as actively immune until they have been tested on their immunity.

ENZOOTIC HEPATITIS, OR RIFT VALLEY FEVER.

(An undescribed Virus Disease of Sheep, Cattle and Man.)

By R. Daubney and J. R. Hudson.

In July, 1930, an application was received for assistance in diagnosing a disease that was causing a heavy mortality in newly born lambs on a farm in the Rift Valley. The farm in question is situated at an altitude of 5,500–6,000 feet, and extends northwards from the shore of Lake Naivasha. It consists of about 30,000 acres of open bush country, and has carried Merino sheep successfully for a number of years.

Normally, lambing takes place on this farm in October and November, but on this occasion it was decided to lamb during July and August, which are usually dry months. The peculiar climatic conditions in East Africa make it a matter of some difficulty to choose the most suitable periods for lambing. The choice of a season has been narrowed down by experience to the October–November period, which is just before the short rains, or to the month of May just after the long rains. Further experience is leading to a general adoption of the October–November lambing season as being more suitable, since it has been found that lambs born during May suffer much more heavily from parasitic infestations than those born in the October–November season. In deciding to lamb in July and August this year the manager of this farm was no doubt largely influenced by the unusual rainfall, which had been sufficient to ensure good grazing throughout the dry season, and by a fear that should the short rains in November also prove to be unduly heavy the pastures might become rank and unsuitable for young sheep. The mean annual rainfall in

the Naivasha region is approximately 25 inches, distributed as follows :—

January	...	0.73″
February	...	1.04″
March	...	2.44″
April	...	4.59″
May	...	3.61″
June	...	2.65″
July	...	1.75″
August	...	2.02″
September	...	1.27″
October	...	1.32″
November	...	2.38″
December	...	1.13″

During the year 1930, over 45 inches of rain were recorded, 31.44 inches falling during the " long " rains of February–May, and 8.54 inches during the " short " rains from September to November.

During the latter part of June, before lambing had commenced, a number of abortions occurred in the ewe-flocks. At first it was thought that these abortions were due to bluetongue, since on two occasions blood taken after ewes had aborted, produced bluetongue on inoculation into susceptible sheep at the Laboratory. However, other samples similarly collected failed to transmit bluetongue on inoculation.

Shortly after lambing commenced, it was realized that some disease was causing an unduly high mortality in the lambs of certain flocks. At the outset the disease appeared to be confined to the lambs of one ewe-flock, and by July 10th, sixty lambs had died out of a total of eighty born in this flock. At the time of death the lambs were from 3–7 days old, the majority about 3 days. The day before death they were listless, disinclined to feed, and sank down soon after being put on their feet. Diarrhoea was not a feature of the condition, and the symptoms were not very definite. Affected lambs rarely survived twenty-four hours after the first appearance of symptoms.

Coincident with the appearance of this disease in lambs there was a marked rise in the mortality rate of ewes on the farm, and the number of abortions also increased. In contradistinction to the position with regard to the lamb disease, both mortality and abortion were observed among ewes in practically all flocks on the farm. The ewes were either

found dead without having shown previous symptoms, or were observed to be ill for a few hours only before death. In some cases it was stated that they were observed to vomit in the evening and were found dead the next morning. When observed to be ill, the sheep showed a thick muco-purulent nasal discharge, and occasionally the stools would consist of almost pure blood. They were not feeding, were disinclined to rise, and at this stage had a normal temperature. Ewes that aborted were not visibly ill at the time, with the exception of a few animals that developed septic metritis or peritonitis.

On the 27th July, a second visit was made to this farm. It was found that the situation had become far more serious and that the lamb disease had extended, or rather, that cases were now occurring in all the flocks of lambing ewes. Abortions among the ewes had almost ceased, but the ewe mortality was now extremely heavy.

A fortnight later, when a third visit was made, the position was much the same. The total mortality in lambs had by now reached approximately 3,500, and upwards of 1,200 ewes had died.

By this time, it was already known from experiments that the disease in the lambs was a hyperacute form of that in the ewes, and that abortion was a common sequel to recovery in pregnant animals. It had been decided to remove the ewes and the remaining lambs by easy stages to an adjoining farm on the edge of the Rift Valley, at an altitude of 7,000–8,500 feet. Some of the flocks were then on their way to the higher farm, and both ewes and lambs were dying on the road. After the arrival of the sheep at the higher farm, deaths continued for a further period of five or six days. From that time onwards no fresh cases were recorded, and it is reasonable to suppose that those animals that died during the first few days after the movement, had been infected before leaving the lower altitude. As the records of experiments will show, the disease continued on the lower farm for several months and in fact, occasional cases were observed as late as December.

Pathology.

The lesions encountered at post-mortem examination are very constant in young lambs, whether naturally or experimentally infected. In adult sheep the lesions at first appear to be quite different from those found in lambs; this applies more particularly to the liver lesion. Further investigations

have shown quite clearly that this apparent difference depends solely upon the acuteness of the process and upon the rapidity with which the lesions develop.

Liver.—The most striking lesion in lambs is an extensive necrosis of the liver. At the outset this is a focal process, but in a severe case most of the liver tissue is affected. Usually, however, some part of the surface of the organ can be found, which still indicates quite clearly the focal nature of the lesion. The necrotic foci appear beneath the capsule as small, white spots, up to about 1 mm. in diameter. In the neighbourhood of such small foci one commonly finds some scattered pin-point subcapsular hæmorrhages, reddish-black in colour. The liver itself is not enlarged.

When a certain amount of normal tissue remains, its colour is usually relatively unchanged, but occasionally the whole liver may be light yellow in colour. The necrotic foci are distributed more or less evenly throughout the whole of the organ, and when they are sufficiently numerous, coalesce to form a diffuse necrotic lesion. There is never any sign of demarcation of large necrotic masses from surrounding tissue.

On cutting the liver it is found that the lesions visible on the surface extend throughout the substance of the organ. In general, the liver in acute cases shows a striking resemblance to that seen in certain *Salmonella* infections such as fowl typhoid, and to a less extent paratyphoid of calves.

The acute liver lesion described above is only rarely seen in adult sheep; usually the changes are much less advanced. In ewes dying of the natural or experimental disease, the surface of the liver shows innumerable small subcapsular hæmorrhages which appear as pin-head size, reddish-brown areas. These circumscribed hæmorrhages appear to be located at or near the centre of the liver lobules.

Frequently the lobulation of the organ is much more distinct that normal, possibly as a result of distension of the inter-lobular vessels beneath the capsule. Although these congestive or hæmorrhagic foci constitute the main feature of the liver lesion in adult sheep, there is often a small area where distinct pin-head necrotic foci can be seen.

On section the cut surface of the organ usually appears paler than normal; distinct focal lesions, either of the congestive or necrotic type are not usually visible to the naked eye. Increase in the size of the organ is not noticeable, although it is occasionally engorged with blood.

Spleen.—The spleen is not enlarged. *Tumor splenis* has been observed only once in an experimental case in the course of some two hundred post-mortem examinations. The constant lesion is the presence of pin-point to pin-head size hæmorrhages beneath the capsule. These hæmorrhages are chiefly found towards the free border of the organ. Capillary arborescence in the neighbourhood of the petechiæ is of frequent occurrence. The pulp of the organ is not noticeably affected.

The condition of the spleen is an important diagnostic feature, since it enables one at once to exclude Nairobi sheep disease, heartwater and bluetongue as the cause of death.

Kidney.—The capsule of the kidney strips normally, exposing a smooth, cortical surface, which, however, usually shows a few small ill-defined hæmorrhages or some capillary arborescence. On section, both cortex and medulla not infrequently show a few radiating lines of congestion. Otherwise, the tissue appears normal.

Lungs.—The lungs are litle changed. They are normal in size and colour and do not show hæmorrhages. A fairly constant lesion is the presence of small slightly raised areas on the surface of the organ. These areas are irregularly oval in shape, and may be up to an inch in the larger diameter. They are a little paler than the surrounding tissue. The bronchi and trachea show nothing unusual, although the mucous membrane of the larynx may occasionally be markedly congested.

Circulatory System.—Sub-epicardial ecchymoses are common in the region of the coronary grooves on the ventricles of the heart. In addition the left ventricle almost invariably shows fairly extensive sub-endocardial extravasations. In the right heart, lesions are extremely rare. It has been noticed when drawing blood for virus that the jugular vein is always difficult to raise. The mesenteric and omental vessels are always strongly injected. This injection is another characteristic feature of the disease.

Lymphatic System.—The mesenteric lymphatic glands are always enlarged, and on section appear more moist than normal. In most cases there are extensive hæmorrhages in the cortex of these glands.

Alimentary Tract.—The lesions in the alimentary tract are vague and subject to considerable variation. The mouth, pharynx and first three compartments of the stomach show

nothing unusual. The mucous membrane of the abomasum may be faintly congested; or may on occasion show numerous pin-point hæmorrhages towards the cardiac end.

As a rule the duodenum and jejunum are little changed, although the mucous membrane may be catarrhal throughout the small intestine. In addition, the ileum is not infrequently the site of some diffuse hyperæmia; and the cæcum may show areas of congestion which usually appear to be arranged roughly in transverse ridges, but occasionally take the form of longitudinal bands. The cæcal lesion may extend some little distance along the colon, which otherwise shows no change. It should be mentioned that in some lambs the cæcum has been found inpacted wtih a pultaceous mass resembling a canine stool. Further, a few cases in which there is a marked hæmorrhagic enteritis, affecting chiefly the ileum and large intestine and leading to considerable thickening of the mucous membrance, have been seen in adult sheep. In these cases the lumen of the colon is impacted with chocolate-coloured fæces, " tarry " in consistence, and obviously containing a large amount of blood. These animals have shown characteristic lesions of the subacute type, and the blood upon inoculation has produced the more usual form of the disease. It is, however, by no means certain that the " tarry " enteritis is not due to some complicating infection.

There is a very remarkable tendency to rapid decomposition in the carcases of animals that have died of the disease. Sheep that die in the night are frequently too decomposed for post-mortem examination by nine o'clock on the following morning. Doubtless this early decomposition is related to a more or less complete failure of liver function some time before death.

Nervous System.—The only macroscopic lesion found was injection of the meningeal vessels.

Etiology.

After repeated attempts to isolate some causal bacterium from the liver tissue or from other organs, it was found that the disease was due to infection with a filtrable virus. Tissues which, when inoculated proved highly infective, for example, liver and spleen, proved sterile when plated on laboratory media. The virus is present in the blood and in extracts from organs, and is filtrable through the finest laboratory grades of filter. It is resistant, and can be kept in cold store for several months in citrate or in O.C.G. This is important from the point of view of the field worker, since it means

that it is possible to collect blood from an infected animal in the field in citrate or O.C.G., and to despatch it to the laboratory for diagnostic inoculation with the knowledge that it will certainly retain its infective power for some days at ordinary temperatures.

Experimental Transmission.

The disease is transmissible experimentally by the inoculation of blood or of extracts of organs. In sheep, inoculation of infected material provokes a sharp rise in temperature after an incubation period of from twenty-four to forty-eight hours. The mortality from experimental infection in adult sheep is less than 20 per cent, and the induced disease differs in no way from that contracted naturally. In young lambs the mortality from experimental inoculation is probably in excess of 95 per cent, and death may occur as early as thirty-six hours after the inoculation of virus. Recovered animals possess a high degree of immunity, and for this reason it was possible to demonstrate by means of cross-immunity tests that the ewe and lamb diseases were identical.

Natural Transmission.

From the earliest experiments, susceptible sheep have been housed with those reacting to virus. In spite of the fact that the experimentally produced disease differs in no detail from the natural disease, infection by contact has never occurred. When subsequently tested on their immunity contact animals have invariably proved susceptible.

Experiments in the field, designed to test the possibility of transmission from ewe to lamb by contact and by feeding milk, broke down owing to the rapidity with which the disease spread to all parts of the farm, including the buildings. At the laboratory, nursing ewes have on occasion been inoculated with virus; have reacted, and have even died without infecting their lambs. Conversely, young lambs have frequently been infected by inoculation and have died without infecting their mothers. Lambs have also been fostered on ewes whose own lambs have been killed by the experimental disease without any transmission taking place.

To sum up, one can state that a disease which in the field was able to assume the proportions of a serious epizootic, failed to spread naturally in the sheep population at the laboratory, in spite of the close contact maintained, and of the proved susceptibility of the great majority of the animals. The most feasible explanation of this state of affairs would be that the disease was indirectly transmitted from animal to animal and that the necessary transmitting agent was absent

from Kabete. Further light was thrown on this problem by the result of a field exposure experiment that we were able to arrange on the farm where the disease first occurred. From the results of this experiment it was concluded that in all probability transmission is effected by some insect that is sufficiently large to be excluded by an ordinary mosquito net, and which feeds chiefly at night. This hypothesis is supported by certain features in the history of the original outbreak. It will be recalled that on the 10th August the remaining lambs and ewes were moved to a higher altitude, and that in spite of the occurrence of deaths on the road and for a few days after arrival, there was every indication that the manœuvre had been entirely successful in checking the outbreak. It is logical to conclude that some vector that had been operating at the lower level was absent at the higher. As a matter of fact mosquitoes, which have been particularly numerous in the valley this year, are rarely seen on the higher pastures.

The evidence points strongly to a species of mosquito belonging to the genus *Tæniorhynchus* as the vector, and it is intended to continue systematic catching of mosquitoes in the Rift Valley throughout a complete year at least.

The Disease in Goats.

The only goat inoculated with the virus gave a reaction, identical with that shown by sheep, and recovered. No outbreaks have been reported in goats, although when ewes have been aborting heavily in an infected area, reports of abortions in pregnant goats have also been received.

The Disease in Cattle.

Cattle are susceptible to the virus, and a natural outbreak of the disease has been observed in a dairy herd. This outbreak occurred on a farm situated in Solai, in the Rift Valley, between thirty and sixty miles from the first outbreak in sheep. There were no sheep on this farm, but sheep and goats belonging to native squatters on a neighbouring farm were reported to be aborting in large numbers. About fifty cases of illness were observed in the dairy cows. There were three deaths during the acute attack, and a further four deaths from *sequelæ* such as abortions. Symptoms were not very definite, attention being first drawn to the illness by a more or less complete temporary cessation of lactation. The animals' coats were staring, and occasionally they refused to feed. Salivation was a common symptom, and at times there was a fetid diarrhoea. There was never any lameness nor stiffness of the limbs. In most cases temperatures were not recorded, but

during a visit to the farm, when three of the affected animals were examined, one that was salivating and purging was found to have a temperature of 107°. Blood from this animal was despatched to the laboratory for inoculation.

This blood was inoculated into two bullocks, two sheep known to be immune to enzootic hepatitis, and two sheep susceptible to the disease. The bovines, which incidentally had been bred in the Rift Valley, failed to react, as did the two immune sheep. The susceptible sheep reacted typically, recovered, and subsequently proved immune to a sheep strain of virus. These inoculations, together with a further series of inoculations of the original virus, and of a passage of virus from one of the susceptible sheep proved conclusively that the bovine disease was Rift Valley fever.

Apart from dullness and inappetence the only symptom shown by the experimentally infected cattle was the presence of a blood-stained mucous nasal discharge. The temperature reaction commences, on the average, about twenty-four hours later than it does in sheep. Post mortem, the lesions resemble those produced in adult sheep.

During the course of the investigation, upon which four Europeans were engaged, all four developed a dengue-like fever, which we now know to have been due to infection with this virus.

In every case the onset of the attack was characterized by a very brief period of general malaise, followed rapidly by sharp rigors and headache. The temperature rose to about 103°, and the face was brightly flushed. In from three to six hours after the rigors had passed off, pains developed in or near the joints extending from the base of the skull to the extremities. Fever persisted for a period of from 12–36 hours, and the pains gradually disappeared within about four days. One of us had a second temperature reaction, accompanied by similar symptoms, three days after recovery from the initial attack. He complained of headache and defective vision for some weeks afterwards.

Upon enquiry we found that almost every native engaged in herding sheep during the original outbreak had been ill for some four days and had complained of fever accompanied by severe pains. At the time these illnesses were ascribed by the manager to eating the somewhat decomposed carcases of dead sheep.

The manager of the farm in Solai where the outbreak in bovines was discovered, also contracted the disease, in fact

it was his description of what he considered to be an attack of influenza, that made us suspect the true nature of the disease occurring in his cattle.

The disease has been inoculated to man and symptoms identical with those that we experienced, were reproduced.

Only one horse has been inoculated with virus, and this animal failed to react.

Two pigs have been inoculated with virus taken from an acute case in a lamb; neither of the two reacted in any way.

Control by Inoculation.

Owing to the early age at which lambs die of Rift Valley fever during an outbreak, it is obvious that the only useful method of conferring immunity is by using an anti-serum. In an outbreak as extensive as the one that was responsible for these investigations, there would be few lambs that would escape a dose of virus during the time that a dose of anti-serum given shortly after birth would still be effective. A hyper-immune serum has been prepared which under laboratory conditions has considerable protective power. Should an outbreak of the disease occur in 1931, it is hoped to test it in a controlled field experiment.

It is difficult to gauge the efficacy of any prophylactic introduced for adult animals, owing to their relative insusceptibility. Two batches of a formalized vaccine, similar to the Kabete rinderpest vaccine, have been made and have been tested. The results are given in Tables 1 and 2.

TABLE 1.

TEST OF FORMALIZED ENZOOTIC HEPATITIS VACCINE (1 in 1,000) BATCH 1.

Tissue Used	Sheep No.	Doses	Reaction as the Result of Vaccination	Result of Immunity Test
		One dose of		
Liver ..	3610	10 c.c.	Nil	Reacted, not off feed, recovered.
	3622	5 c.c.	,,	Reacted, not off feed, recovered. Very mild temp. reaction only.
Spleen ..	3595	10 c.c.	,,	Reacted, not off feed, recovered.
	3602	5 c.c.	,,	Very mild temp. reaction only.
Kidney ..	3587	10 c.c.	,,	Reacted, not off feed, recovered.
	3611	5 c.c.	,,	Reacted, died, lesions typical.
Control ..	3322	..	..	Reaction much earlier than vaccinated animals. Temperature rose higher but animal recovered.

TABLE 2.

TEST OF FORMALIZED ENZOOTIC HEPATITIS VACCINE (1 in 1,000) BATCH 2.

Tissue Used	Sheep No.	Doses	Reaction as the Result of Vaccination	Result of Immunity Test
		One dose of		
Liver ..	3204	One dose of 10 c.c.	Nil	Temperature only.
	3690	Two doses of 5 c.c. at interval of 10 days.	,,	No reaction.
Spleen ..	3201	One dose of 10 c.c.	Nil	Mild temperature reaction only.
	3690	Two doses of 5 c.c. at interval of 10 days.	,,	Very mild temperature reaction only.
Kidney ..	3692	One dose of 10 c.c.	,,	Temperature reaction delayed, but was rather high. Animal recovered without symptoms.
	3685	Two doses of 5 c.c. at interval of 10 days.	,,	Mild temperature reaction only.

Controls for 3204, 3201 and 3692 : 3589 and 3594 reacted and died.

Controls for 3690, 3202 and 3685 : Bovine 6039 reacted and recovered ; bovine 6216, No noticeable temperature reaction.

Experiments with formalized vaccine are being continued. At present spleen appears to give the best vaccine.

Discussion.

This disease has undoubtedly existed in the Rift Valley for some years and from time to time it has been responsible for extensive losses both in adult sheep and in young lambs. No precise records are available, but according to information obtained from stockowners in the district certain wet years have been noticed for an excessive number of abortions and a heavy mortality in adult sheep. In other wet years the chief feature has been the mortality in very young lambs. In each case there has been a history of abortion in cattle and a dengue-like fever in man, occurring at the same time. The mortality in lambs has generally been attributed to a bacillary infection, probably to *B. coli*, and the mortality in ewes was thought to be due to heartwater, a disease which before the discovery of *Rickettsia* presented considerable difficulty in diagnosis. The dengue-like fever in man would have in all probability failed to attract serious attention in view of the fact

that in such years the incidence of malaria would be unusually high. In the year 1926 at least three stockowners suffered from a heavy mortality among ewes and a high abortion rate. There is also a history in this year of numerous abortions among cattle and the occurrence of a dengue-like fever of man, both among natives and Europeans. The incidence of malaria in 1926 was the highest for some years.

In the light of our experience the two chief factors concerned in the natural control of the disease appear to be the lower susceptibility of adult sheep and the distribution of the vector. The numbers of the vecting insect appear to be controlled by climate which operates by limiting its distribution both geographically and seasonally. If lambing is taking place when and where the vector attains its peak in numbers, heavy mortality among young lambs is to be expected. If on the other hand it is possible to arrange that lambing shall fall at a time when the vector is not normally active, or if it is possible to lamb at higher altitudes where the vector does not occur, mortality may be greatly reduced.

In the light of these facts it has been possible to prevent serious outbreaks on the farms in the vicinity of the original outbreak during the present year. On one farm the disease caused mortality in the ewe flocks during the whole of the period June–September. Before lambing in November the flocks were moved to higher country and no cases of the disease were reported. On another farm the disease was responsible for mortality in ewes and rams. In a small ram flock there was a mortality of roughly 30 per cent during August and September, and in one of the ewe flocks some forty abortions were reported, while an examination of the ewes indicated that a much larger number of abortions had actually occurred. Diagnosis was confirmed by blood inoculation, and although lambing was timed to commence within three weeks the owner was advised to move the ewes to a higher farm. Only two or three cases of the disease were diagnosed in the lambs born after movement. A similar movement was carried out from the third farm with equally successful results. Here a few ewes were retained to lamb at the home farm, and in their lambs a mortality in excess of 50 per cent is reported to have occurred.

We are unable to trace any reference to this disease or to any similar disease in literature or in the records of this laboratory, and differential diagnosis from the better-known sheep disease offers no difficulty. The four common virus

diseases of sheep in Kenya are Nairobi sheep disease, bluetongue, heartwater and sheep-pox. Sheep-pox is readily distinguished as a member of the *variola-vaccinia* group. The incubation period in Nairobi sheep disease is slightly longer than that of Rift Valley fever, and the disease is not transmissible to bovines. Moreover the chief symptoms in Nairobi sheep disease is diarrhoea, and at death characteristic lesions are found in the stomach, cæcum, colon and kidneys. The incubation period of bluetongue is from 7 to 10 days after blood inoculation and in a natural outbreak the mouth lesions are characteristic. Heartwater has a simliar incubation period to bluetongue and here again the lesion from which the disease takes its name is found in a percentage of cases. In Nairobi sheep disease, bluetongue and heartwater *tumor splenis* is a constant post-mortem lesion while it has only been observed once in Rift Valley fever. Animals known to be immune to all these diseases were frequently employed in the early transmission experiments, and almost every animal inoculated with the virus of enzootic hepatitis has also been used either before or afterwards in Nairobi sheep disease experiments without any evidence of cross-immunity being detected.

The only disease of cattle with which Rift Valley fever might possibly be confused is three-day sickness which has been variously referred to in literature as three-day sickness, stiff-sickness, ephemeral fever and dengue. Three-day fever of cattle in Africa is a mild inoculable febrile disease of short duration, characterized by muscular and articular pains and stiffness. Affected cattle are invariably lame in one or more limbs and may be so badly affected as to be unable to rise. The illness lasts from three to five days and is followed by a rapid and complete recovery. There are records (unpublished) in this laboratory of certain experiments carried out by Montgomery, in which the incubation period of three-day sickness after blood inoculation is shown to be from five to eight days, as against three to five days for enzootic hepatitis in cattle. Moreover, Montgomery was unable to transmit three-day sickness to sheep, although some twenty sheep were inoculated on various occasions with blood containing the virus.

Clinically, three-day sickness is a well defined and easily recognized disease. It is relatively common in certain years in Kenya Colony, and does not differ in any way from the disease described by responsible workers in other parts of Africa. Unfortunately, the name " dengue " has been applied to this disease of cattle by various authors. Although there is some uncertainty as to the identity of the disease with

which some of the older authors were working, the " dengue " of Piot-Bey (1895), Hutyra and Marek (1916), Walker and Edmonds (1929) and Tarantino (1929) is undoubtedly the disease known to us as three-day sickness.

The true dengue of man is not transmissible by inoculation to cattle [Melanidi and Stylianopoulo (1930)]. We can trace no records of attempts to infect sheep. This brings us to the question of the identity of Rift Valley fever as observed in man with true dengue; and here, in addition to the difference in behaviour of the viruses in cattle, the absence of a rash in Rift Valley fever in man is of assistance in distinguishing the diseases in clinical practice.

The clinical resemblance of the disease in man to true dengue is of particular interest when considered together with the remarkable agreement histologically between the liver lesion in sheep affected with enzootic hepatitis and that found in yellow fever in man. If our tentative conclusion, that *Tæniorhynchus* transmits enzootic hepatitis, is correct, this is additional evidence of the relationship of the viruses especially since it has recently shown that *T. africanus* can transmit yellow fever under experimental conditions. (Philip, 1930.) These three diseases seem to fall into a natural group.

We have proposed the name of Rift Valley fever as a popular alternative to our first suggestion, enzootic hepatitis, which was originally applied to the disease in sheep. The latter is hardly a suitable name for the human disease, since we have as yet no evidence that the liver is involved in man. While realizing the disadvantages of attaching a geographical name to a disease, we feel that convenience necessitates the use of some such term.

A detailed account of the experiments upon which this report is based is in press. In this account the characters of the causal virus are dealt with more fully, and the histology of the lesions is described in full. In certain respects the characteristic liver lesion shows remarkable resemblances to the diagnostic liver lesion in yellow fever of man.

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NAIROBI SHEEP DISEASE.

By R. Daubney and J. R. Hudson.

In 1912 and 1913, Montgomery described in the Annual Reports of the Veterinary Pathologist for the years 1910–11 and 1911–12, a tick-borne gastro-enteritis of sheep and goats, for which the name Nairobi sheep disease has passed into general use. In a comprehensive paper dealing with his work at Kabete he was able to show that the causal agent was a filtrable virus, transmitted by *Rhipicephalus appendiculatus*, the ordinary brown tick and common vector of East Coast fever in cattle. In spite of Montgomery's careful description of the lesions, of his record of failure to infect cattle and of his successful filtration experiments there has been until recently a lot of confusion between this disease and heartwater. During the course of certain investigations on heartwater, the opportunity was taken to compare the two diseases and to confirm and extend Montgomery's observations.

Two strains of virus were quickly obtained, one by exposing sheep from the Narok area in the Kikuyu Reserve near the laboratory and the other by requesting natives to bring to the laboratory any sheep suffering from the disease. These two strains proved identical, and conformed in every way to the characters given for the virus of Nairobi sheep disease by Montgomery.

Symptoms.

On exposure in an infected locality the first symptom is an acute febrile reaction which may commence within five or six days of the date of exposure. The temperature reaction may last from five to nine days, but in a hyperacute case it falls suddenly after three or four days. With the fall in temperature other symptoms of illness will appear if the case is likely to terminate fatally. In less acute cases the temperature falls steadily after being elevated for from four to six days and the animal may develop other symptoms and die, or may show a second temperature reaction after a remission of from three to seven days. This second reaction may terminate fatally, but more generally it is followed by recovery without the development of any noticeable symptoms.

The visible symptoms, which if at all marked may be regarded as an extremely unfavourable prognostic sign, are the presence of a muco-purulent nasal discharge, rapid and apparently painful respiration, and bright to dark green, watery diarrhoea. In the later stages the animal ceases to feed and becomes unable to rise. The fæces may contain

mucus and flecks of comparatively unchanged blood before death. The vulva and external genitals of ewes are swollen and congested at this stage, and pregnant ewes frequently abort.

Post-Mortem Lesions.

Post mortem, the carcass may be in good or bad condition, depending on the duration of the illness. Macroscopic lesions are found in the alimentary tract, spleen, kidney, heart and trachea.

Alimentary Tract.—The mucous membrane of the abomasum may be diffusely congested over its whole surface or lesions may be confined to the cardiac portion; in the latter case it is common to find lenticular or pin-point hæmorrhages. The mucous membrane is rarely thickened to any appreciable extent.

The duodenum and jejunum may be catarrhal or even hæmorrhagic; usually however the lesion is not marked in this part of the small intestine. The ileum shows a varying degree of congestion and submucous hæmorrhage, which may extend throughout its length, but which is more common in its posterior part. The lesion in the ileum is always more severe towards the ileo-cæcal valve. The ileo-cæcal valve is swollen and raised, and in a severe case may be ulcerated and port wine coloured.

The cæcum and the first part of the colon are usually the seat of the most severe lesion in the alimentary tract. There is extensive hæmorrhage into the mucosa and typically the lesion is disposed in longitudinal bands or *rugæ*, which stretch from end to end of the cæcum, and usually extend some distance into the colon. In a severe case these longitudinally striated hæmorrhages may be found extending throughout the large intestine to the anus. The contents of the cæcum and colon are fluid and usually somewhat stained with blood.

Spleen and Lymphatic Glands.—There is always a well marked *tumor splenis* and at times the organ may be enlarged to five or six times its normal size. The malpighian corpuscles are prominent, and the organ contains an excess of blood. The lymphatic glands throughout the body are enlarged, and more moist in consistency than normal.

Kidney.—The capsule of the kidney strips perfectly and the cortical surface commonly shows ecchymoses. On section there is invariably some nephritis, which in later cases is followed by marked congestion of the medulla and boundary

layers. The medulla may appear to be considerably enlarged at the expense of the cortex. The cut surface of the cortex is granular in appearance and may show evidence of congestion.

Heart.—The pericardium may contain some excess of clear fluid. The heart usually shows petechiæ on the epicard and œdema of the coronary grooves. The left heart invariably has ecchymoses on the endocard.

Trachæ.—The submucous vessels are usually congested but actual hæmorrhage is rare.

Liver.—Although the liver shows no macroscopic lesions, the gall bladder is usually distended with bile which is abnormal both in colour and consistency. It may be grumous or syrupy and may vary in colour from light golden to dark brown.

Genital Tract.—In ewes there may be an inflammatory condition of the whole of the genital tract. The vulva, vagina and uterus may be swollen and congested and their mucous membranes in a catarrhal state. The lesions are more marked in pregnant ewes and they may involve the fœtus and fœtal membranes if abortion has not already occurred. The membranes are thickened, loaded with blood and the amniotic fluid may be bloodstained. The fœtus commonly shows extensive subcutaneous and intracutaneous ecchymoses on various parts of the body.

Etiology.

Location of the virus in the tissues of the sheep.—Montgomery was invariably successful in transmitting the disease by the inoculation of blood or serum taken during the temperature reaction. He was also able to effect transmission by the inoculation of saline extracts or organs, and on two occasions infected animals by the subcutaneous inoculation of urine. A single experiment with pericardial fluid also gave a positive result.

We are able to confirm his finding that blood taken during the temperature reaction is invariably infective. By bleeding into pysiological saline containing sodium citrate and separating the plasma and corpuscles by centrifuging, we were able to demonstrate the infectivity of both the plasma and the cells. Saline extracts of both the spleen and the liver have also proved infective.

Filtration.—Montgomery's results of filtration experiments have been confirmed. In fact in diluted plasma free from hæmoglobin, the virus passes the finest grades of Chamberland candles.

Resistance of the Virus.—Experiments have shown that the virus keeps well in the cold store at ± 5° C. The virus remains viable in citrate solution for periods up to sixty-six days. Blood in O.C.G. has proved infective after storing for ninety-three days, and blood, dried over sulphuric acid, powdered and sealed in ampoules, has retained its infective power for 143 days.

Susceptibility of Animals.—No extended experiments have been made to test the virus on different species of animals. Sheep and goats are susceptible, but all attempts to infect cattle have failed. This non-susceptibility of cattle is an important point of distinction between Nairobi sheep disease and enzootic hepatitis.

In recent experiments, Masai sheep from the Narok area have proved much more susceptible than grade sheep or than native sheep from other areas. This fact was also commented on by Montgomery.

Immunity.—Recovery from an attack of Nairobi sheep disease gives a high-grade immunity which lasts for at least one year. In only two sheep has a breakdown in immunity been observed and in these animals the virus causing the second attack was of peculiar origin.

Virus cannot usually be demonstrated in the blood later than twenty-four hours after the temperature has fallen, and in cases where there is a secondary rise the blood during the second temperature curve is non-infective.

Transmission.—Nairobi sheep disease, as proved by Montgomery, is transmitted by the brown tick *Rhipicephalus appendiculatus*. Montgomery's observations have been confirmed and extended and it is known that whatever instar is fed on an infected animal the succeeding stage is infective. On feeding an adult female on an infected sheep, the virus passes through the egg to the larvæ.

Ticks only become infected if fed on a sheep during the time that the blood contains virus. During the process of feeding on an immune sheep ticks clean themselves. Also if fed on a susceptible sheep infected larvæ that drop before the reaction commences clean themselves. If, however, they continue feeding until the virus appears in the blood they become re-infected. Ticks that have been infected by feeding on a reacting sheep are infective on inoculation at all times both before and after moulting.

Discussion.

Experimental investigations into Nairobi sheep disease were undertaken to confirm Montgomery's findings and to establish the identity of the disease as a tick-borne disease of sheep quite distinct from heartwater. The differences between the two diseases are set out in Table 1.

TABLE 1

Difference between Nairobi Sheep Disease and Heartwater

	Nairobi Sheep Disease	Heartwater
Incubation period ..	Never exceeds a week.	Never less than a week.
Vector	*Rhipicephalus appendiculatus.*	*Amblyomma variegatum* and *A. hebraeum.*
Resistance of virus ..	Virus survives several months in ice-chest in citrate, O. C. G. or as dried blood	Virus will rarely survive for twenty-four hours in citrate.
Behaviour in cattle ..	Cattle naturally immune.	Cattle susceptible.
Rickettsia	Absent.	Present in capillaries of brain, renal glomeruli, sinusoids of spleen.

Other differences might be mentioned, but of greater importance are the cross-immunity experiments which have occurred frequently in the course of this work. Sheep which have reacted to Nairobi sheep disease and have subsequently been found immune on test, have contracted heartwater and died. Conversely sheep that have reacted to heartwater have later been found susceptible to Nairobi sheep disease. Native sheep from the Narok area are highly susceptible to Nairobi disease, but are frequently immune to heartwater. On the other hand Kikuyu sheep from the typical brown-tick country around Kabete are frequently found immune to Nairobi sheep disease, but are usually susceptible to heartwater.

Nairobi sheep disease appears to have escaped recognition during the past decade. This is no doubt due to the fact that the Somali sheep trade to Nairobi has declined and also to the fact that European owners of sheep are for the most part settled in areas where *Rhipicephalus appendiculatus* is not a dominant species of tick. The disease is however of considerable economic importance in the Kikuyu Native Reserve.

Fuller details of the experiments on which this report is based are in press.

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CONTAGIOUS PUSTULAR DERMATITIS OF SHEEP.

By J. R. Hudson.

Since Stordy first recorded this disease from sheep on the Uasin Gishu Plateau in the Annual Report of the Department of Agriculture for 1912-13, there has been no published record of its occurrence in Kenya. Hornby in 1925 and Cornell in 1928 have described the condition in native sheep and goats in Tanganyika Territory in the Annual Report of the Veterinary Pathologist.

During 1930 an outbreak occurred in sheep in the North Kenya district. Owing to the fact that grazing was plentiful at the time, the disease was not responsible for serious symptoms or mortality.

Identity of the Condition.

A strain of virus was obtained from the lip of a cross-bred weaner. A nodule was removed, minced with scissors, and suspended in normal saline. Half of the material was centrifuged and samples both centrifuged and uncentrifuged were inoculated by scarification on the thighs of sheep.

The uncentrifuged material gives rise to staphylococcal pustules on the second day. All the sheep showed erythema on the lines of scarification on the third day. In the two sheep that received uncentrifuged material the staphylococcal pustules then obscured the subsequent reaction, but sunk, dull-white, small oval vesicles appeared in the lines of erythema on the others on the fourth day. By the seventh day, these had developed into large, white umbilicated vesicles. These later became pustules, which broke, and the pus began to dry about the tenth day. The scabs were collected on the fourteenth and fifteenth days.

The times at which the various stages appeared agree closely with those reported by Glover (1928) in contagious pustular dermatitis of sheep in the Eastern Counties. Glover in a more recent paper (1930) states that lambs immunized with an English strain of virus from sheep are completely resistant to a strain from goats sent from Tanganyika. Although cross-immunity experiments have not been performed there is no reason to doubt the identity of the disease in Kenya with that in other parts of the world.

Distinction from Sheep-Pox.

Experiments carried out by several authors prove that the disease is caused by a virus which belongs to the pox group. That there is no cross-immunity between pustular dermatitis and vaccinia has been shown conclusively by a number of workers, and cross-immunity experiments between sheep-pox and a caprine strain of dermatitis virus are reported by Blanc and his co-workers. With the idea of confirming their finding of lack of cross-immunity two sheep (sheep 3743 and 3746) which had recently been used to test sheep-pox vaccine were inoculated by scarification with a fresh 1 in 1,000 suspension of dried crusts that had been kept for six months. A typical reaction ensued in both animals.

A young weaner (sheep 3528) that had been inoculated with dermatitis virus and had recovered, was used in the production of a batch of sheep-pox vaccine. The animal gave a mild temperature reaction and developed pustules from which virus was subinoculated to other sheep.

It appears, therefore, that no cross-immunity exists between contagious pustular dermatitis and the strain of sheep-pox that exists in East Africa.

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SOME PARASITES OF DOGS IN KENYA.

By W. B. C. Danks.

During the course of routine duties for the year, the writer has observed the following parasites from the dog : *Hepatozoon canis*, *Spiroptera sanguinolenta* and a microfilaria, the species of which has not been determined.

Two of these are of some clinical significance and are certainly of importance with regard to differential diagnosis, especially so in the case of *Spiroptera sanguinolenta* which will be described.

The third, a microfilaria occurring in the blood of dogs, has up to the present not been experimented with to any extent and its significance has so far not been determined.

Hepatozoon canis.—This is a parasite occurring in the leucocytes of dogs which gives rise to a mild type of anæmia, and the evidence so far obtained from experiments carried out points to the possibility of this parasite being responsible for some " break-downs " to tick fever in recovered dogs.

The parasite has been described by Bentley (1905) and James (1905) in India. It was found by Gerrard (1906) in Malaya, by Christophers (1906) in Madras, by Wenyon (1911) in Baghdad and by various workers in other countries.

The attention of the writer was first drawn to this parasite by Cowdry who identified the parasite in blood smears from an affected dog.

Later the writer identified the parasites in smears from two dogs both of which appeared to have symptoms resembling distemper. One of the dogs died and the spleen, liver and lungs were obtained for examination.

The parasite is usually found in the transitional leucocytes the nuclei of which are as a rule horse-shoe shaped. It may also be found in the polymorpho-nuclear leucocytes. The parasite is often seen lying in the space between the arms of the shoe, but it may lie at other angles. In only one case was it observed lying free in the plasma.

The mature parasite appears as an oval-shaped encapsuled body with the nucleus either at one end or in the centre near one side. It may also appear as a clear space in the cytoplasm, no nucleus being obvious. Other forms appear as smaller round bodies with little or no clearly defined capsule. The parasites are about 8–11 micron in length.

The schizogony cycle of the parasite takes place in the spleen and takes the form of a large round or oval-shaped cyst-like body about 19 micron in diameter. In sections of the spleen submitted for examination this stage had a reticular network with, in some cases, one or two large irregular chromatin masses and in others, more fully developed, numerous nuclei were present. This stage has not so far been seen by the writer in the bone marrow or liver.

External parasites, ticks and fleas, were obtained from one of the original cases previously mentioned, and transmission experiments were carried out with each. In no case did ticks transmit the disease. Fleas transmitted the disease in three cases, one of which had failed to react with the ticks.

A parasite which the writer believes to be the stage in the intermediate host, was found in some of the original fleas submitted and again in about 20–30 per cent of the fleas subsequently examined from the reacting experimental animals.

Various stages of this parasite were seen, one resembling that seen in the blood only much deeper stained with a clearer defined nucleus. Also a pear-shaped smaller form with nucleus and kineto-nucleus from which, in some instances, a distinct flagellum arose; a round slightly larger form than the foregoing with a clear cytoplasm containing scattered chromatin granules. Another form consisted of a number of club-shaped parasites arranged in a concentric mass resembling the petals of a flower.

Further experiments are being carried out both with ticks and fleas and the complete results will be published at a later date.

Spiroptera sanguinolenta.—This appears to be the first time this parasite has been recorded from this Colony.

It is one of the nematoda (round worms) blood-red in colour, the male measuring from about 3–5 cm. with spiral tail and the female 6–8 cm. long with curved tail. It is usually found in nodules or tumour-like swellings in the wall of the œsophagus (gullet) or stomach.

The case diagnosed by the author was in an Alsatian dog about one and a half years old. The symptoms described by the owner were as follows : The dog was apparently feeding normally with no vomition, but suffered from periodical fits of excitement; the dog was continually snapping and appeared mad. The owner considered it unsafe and had it destroyed. The dog was sent to the laboratory for post-mortem examination. On opening the chest cavity and removal of the lungs, a tumour-like swelling about the size of a pigeon's egg was seen on the wall of the œsophagus. This tumour had an opening into the chest cavity and an examination of the adjacent lung and pleura showed pneumonia with a localized pleurisy. On opening the tumour, the wall of which was comparatively thick, about eight worms were found lying in a purulent fluid.

Other writers have described symptoms of repeated vomition with voracious appetite. The parasite has frequently been recovered from dogs suspected of rabies and Flemming (1892) states, "and it may also be the case that this nematode at times induces rabiform symptoms, which have led to mistakes and caused dogs presenting them to be sacrificed as rabid." It is the opinion of the writer that this statement was borne out by the case brought to his notice.

Grassi (1888) reported the cockroach as being the intermediate host of the parasite. It is probable that the cockroach becomes infested from the fæces of affected dogs and it in turn may be eaten by another dog and so pass on the infection.

Microfilaria in Dogs.—This larval or embryo form of the parasite measuring about 210 micron (roughly about 1/5 mm.) in size has been seen in blood smears from two dogs, one a puppy about six months old, and the other an aged airedale. This parasite belongs to the class of round worms and the order *Filarioidæ*. The larval forms of these parasites are found in the blood of man and many domestic animals, and the parasite gives rise to various symptoms chyluria, hæmaturia, lymphatic enlargements and in man elephantiasis. One of this order, *Dirofilaria immitis*, occurs in the right ventricle of the heart and pulmonary artery of dogs and is not infrequently a cause of death. Its presence in the kidneys may give rise to hæmaturia, a condition which has been noticed by the writer in dogs in this country, and the cause of which has not been determined.

The embryo in the blood is about 1/5 mm. in length, the head end rounded and the tail distinctly pointed. It is enclosed in a sheath and the body is composed mainly of exceedingly small somatic cells.

A PRELIMINARY NOTE ON SPIROCHÆTOSIS OF PIGS IN KENYA COLONY.

By W. B. C. Danks.

There is a condition amongst pigs in Kenya Colony in which the lesions vary, but usually take the form of soft or hard subcutaneous swellings.

Spirochætes and fusiform bacilli have been found associated with those lesions.

Either or both of these parasites have been deemed by other writers to be the causal organism.

History.

Dodd (1906) found spirochætes associated with an ulcerative dermatitis of pigs in South Africa.

Cleland (1908) in West Australia found a similar parasite associated with fibrous nodules occurring in castration wounds of hogs, and Gilruth (1910) found them in ulcerating wounds on various parts of the body and in submucous cysts of the large intestines.

According to Mattes, spirochætes caused a severe affection of hogs in the lowlands of Erythræa.

References are also made to this parasite by Hutyra and Marek (1926), Vol. 1, page 1079, (Hoare (1913), Vol. 1, page 1238, Wenyon (1926), Vol. 11, page 1259.

Gill (1929) also describes an ulcerative dermatitis of pigs associated with the presence of spirochætes in the lesions.

Neitz and Canham (August, 1930) published a report on the occurence of a chronic disease of swine in South Africa caused by a spirochæte or the associated fusiform bacillus or both. Some of the cases described by them appear to be identical with those seen by the author in Kenya Colony.

General Remarks.

Spirochætosis of pigs in Kenya Colony is now known to occur in the Rift Valley, Kinangop and Nanyuki areas, and probably also occurs in many other parts of the country.

The disease was first suspected in this Colony towards the early part of this year. A disease was reported amongst pigs in which the main symptoms appeared to be the occurrence of swellings on various parts of the body, varying in size from a walnut to a coco-nut. The affected pigs fell considerably away in condition and were considered by the farmer to be unprofitable to rear in this country.

It occured to the writer that the disease resembled spirochætosis and an attempt was made to procure some cases for diagnosis and experimental purposes.

In June of this year two cases were submitted from Gilgil in the Rift Valley area. From information received the disease had evidently been seen on several occasions previously in that area.

Climatic conditions appear to have some influence in the occurrence of the disease, outbreaks being more prevalent during the rainy seasons. Infection is probably conveyed from the soil and hygienic conditions play an important part in the incidence of the disease.

Natural infection, there can be no doubt, occurs from the associated organisms gaining entrance through wounds or abrasions of the skin (the writer at present is not in a position to make any statement regarding the possible portal of entry caused by wounds resulting from the bites of ticks or biting flies so common in this country).

It is improbable that infection takes place through the unbroken skin or mucous membrane. The commonest method of infection appears to be through castration wounds and consequently the lesion most frequently seen occurs in the scrotal region.

Etiology.

The organisms associated with this disease are a spirochæte and a fusiform bacillus, the former being the more predominant.

The spirochæte measures from about 4–15 micron with from 2 to 6 complete spirals, each turn of the spiral varying from about 2 to 4 micron.

The organisms are easily stained by Geimsa's method and this stain was used during the investigations.

It would appear from the results obtained from post-mortem and microscopic examination that the organism is confined to the lesion.

Numerous blood smears were examined with negative results.

Susceptibility.

There is evidently no factor influencing the susceptibility of pigs exposed to the infection. Pigs of all breeds, age, sex or condition appear to be affected, but the disease is found most frequently in young hogs, due to the fact that under unhygienic conditions the wounds resulting from castration form an easy portal of entry for the parasite.

Symptoms.

The animal is generally in poor condition and swellings varying in size and consistency are found on different parts of the body. Up to the present the writer has found the lesions usually confined to the scrotal region.

Anatomical Changes.

In June, the writer received two cases for post-mortem examination. In each case the lesions were confined to the scrotal region and consisted of hard tumour-like swellings; in one case slightly larger than an orange and in the other about the size of a coco-nut.

On dissection of the scrotum it was found that the skin was attached by adhesions to the underlying tumour. This tumour-like mass on section consisted of a thick laminated fibrous capsule, the inner layers of which were of inflammatory tissue followed by an innermost layer of yellowish-brown caseous matter. The inner surface of this innermost layer had a pocked appearance. This capsule surrounded a cavity filled with a greyish-yellow granular pus.

Smears from this pus showed a predominance of spirochætes over other organisms mainly fusiform bacilli.

Examination of stained sections of this capsule revealed from the inner surface outwards a mixed infection consisting of mainly spirochætes and fusiform bacilli followed by an almost pure infection of spirochætes in the inflammatory zone. With the exception of, in one case, the kidneys, each of which had a retention cyst about half an inch diameter, the other organs appeared to be normal.

Experiment.

Some of the pus was withdrawn from the swelling by means of a needle and syringe before one hog was killed, and this pus was inoculated subcutaneously behind the shoulder of another pig. About the fourth day following inoculation, a small swelling was noticed at the site of inoculation. This increased in size until on the eleventh day it had reached the size of an orange.

On the thirteenth day, this swelling burst discharging a greyish-yellow pus. Smears from this pus showed spirochætes and fusiform bacilli. By the sixteenth day a considerable amount of fibrous tissue had formed in the affected part. There was a hard swelling in this region on the nineteenth day with a little pus still oozing from the wound.

About the twenty-fifth day the discharge had ceased and the wound had healed leaving a hard fibrous tissue nodule under the skin.

Fluctuations in temperature took place from the sixteenth day after inoculation onwards.

Conclusion.

(1) There seems to be no doubt that a disease occurs in pigs due to the invasion of spirochætes or the associated fusi form bacilli or both through abrasions or wounds of the skin.

(2) That this disease in Kenya appears to cause a serious loss of condition in the animal, thereby making those affected unprofitable to rear under present conditions

OBSERVATIONS ON VACCINATION OF YOUNG CHICKS ONE TO EIGHT DAYS OLD AGAINST FOWL-POX.

By W. B. C. Danks.

The object of these experiments was to ascertain whether very young chicks could be successfully vaccinated and immunized against fowl-pox, as it has been reported that in some outbreaks mortality had occurred in chicks under the age at which vaccination had previously been recommended, i.e. five weeks old.

For the experiments day-old chicks were obtained from a reliable source where no outbreak of fowl-pox had occurred. The chicks were reared by foster-mothers, kept in a corrugated iron shed with concrete floor and allowed in fine weather to run on a lawn never previously used for fowls.

The fowl-pox virus used for vaccination and testing was the stock laboratory strain which had given marked reactions in every instance and which consisted of a 2 per cent emulsion of freshly powdered scab in liquid paraffin. The virulence of the virus is retained by periodical passage through batches of susceptible fowls.

The original pigeon-pox virus was obtained from England and was used to inoculate the plucked breasts of pigeons from which the virus used in these experiments was obtained. For the purpose of testing, if an immunity had been established or otherwise through vaccination, live virus was applied to a heavily scarified area on the opposite leg to that on which the vaccine was applied. This seemed to be a suitable method when dealing with very young chicks.

Experiment 1.

To ascertain approximately at what period after vaccination immunity, if any, is conferred on young chicks vaccinated at from one day to eight days old.

Twelve day-old chicks were obtained and three of these (Group 1) were lightly scarified on a small plucked area on the left thigh and vaccine applied. Four days later three others (Group 2) and eight days later three more (Group 3), were similarly treated. The remaining three were retained as controls.

The reactions in each group were marked and on an average commenced about the fourth day after vaccination, attained the maximum about the ninth day and finally disappeared about the eighteenth day. Although the reactions

were fairly heavy no generalization of the infection took place and no mortality occurred. Further, no appreciable difference in health or size could be detected between the vaccinated chicks and the controls.

Twenty-two days from the commencement of the experiment, one chick from each group representing a period of twenty-two days, nineteen days and fifteen days respectively after vaccination, together wtih one control, had freshly prepared live virus applied to a plucked and heavily scarified area on the right thigh. The results are shown in Table A.

TABLE A

Group	No. of chicks	No. of days after vaccination when tested on immunity	Material used for test	Result
1	1	22	Live fowl virus.	No reaction.
2	1	19	Live fowl virus.	No reaction.
3	1	15	Live fowl virus.	On 5th day after test one very small scab was seen which had disappeared by the eighth day.
Control	1	..	Live fowl virus.	Very heavy reaction.

There can be no doubt that an immunity is conferred, through vaccination, on chicks from one to eight days old. Further it would appear that this immunity is almost complete against artificial infection by the fifteenth day after vaccination, and it would be safe to assume that complete protection against natural infection should be attained by that time.

EXPERIMENT 2.

To ascertain if the immunity conferred is present, after two and three months respectively, in chicks vaccinated at from one to eight days old.

In this experiment the remaining two chicks of each of the three groups and the two controls from Experment 1 were used. One chick from each group along with one control had freshly prepared live virus applied to a plucked and scarified area on the right thigh at (*a*) two months approximately after vaccination (*b*) three months approximately after vaccination.

The results are shown in Table B.

TABLE B

No. of chicks tested on immunity	Aprox. period after vacc.	Material used for test	Result	Controls
3	2 months	Live fowl virus	One chick showed follicles swollen. Two small scabs. Very mild reaction	Heavy reaction with large scab.
3	3 months	,,	All chicks showed follicles swollen w th small scabs Mild reaction.	Heavy reaction with large scab.

There was evidently a good immunity against artificial infection still present two months after vaccination, but this immunity had appreciably decreased by the third month. In both cases, however, the vaccination would, in all probability, have still protected against natural infection.

It is interesting to note that the twelve chicks used in the above experiments were placed together in one foster-mother and contact infection did not occur from vaccination although the controls were in constant direct contact with vaccinated chicks for a period of twenty-two days before being used as controls for the virus to which they gave marked reactions.

EXPERIMENT 3.

In this experiment it was proposed to repeat Experiment 2 and also ascertain if any immunity was present against artificial infection at six months after vaccination.

On 13–10–30, twelve day-old chicks were obtained from the same source, and eight were fairly heavily scarified on the right leg; four being left as controls. Two of the controls died, on 16-10-30 and 20-10-30 respectively, from other causes; no lesions of fowl-pox were seen.

By the eleventh day the reaction in the vaccinated chicks was extremely heavy, and four of the chicks were very sick. This heavy reaction persisted and on 29-10-30 one chick died through the infection becoming generalized. The generalization took the form of greyish scale-like scab, which spread along the back and legs, leaving these areas denuded of feathers. A piece of the affected skin was taken from the back, and on section showed typical fowl-pox inclusion bodies. Four more chicks died through the vaccination becoming generalized, and the experiment was abandoned.

There are therefore occasions when vaccination of day-old chicks with live virus is followed by generalization and considerable mortality, although it may be pointed out that in the above experiment the area vaccinated was considerably larger than in the first experiment, and also that the scarification was much more extensive, with the idea that the better the reaction the better the immunity. Further, it was noticeable that the survivors of the vaccinated chicks were considerably stunted in size in comparison with the controls of the same batch.

Experiment 4.

To ascertain if turkey chicks under a week old could be successfully vaccinated and immunized against fowl-pox.

Seven day-old turkey chicks were obtained, and two were vaccinated at that age; two others were vaccinated when five days old, and three were kept as controls.

The reactions, which were fairly heavy, commenced about the fourth day, and continued until approximately a month after vaccination.

One control died from fowl-pox twenty-one days from the commencement of the experiment. (This was the only occasion where a control was infected by what appeared to be direct contact. No lesions were found on the head or in the mouth, the infection taking the form described in Experiment 3, i.e. similar to generalization of the infection after vaccination, portions of the affected skin again showing typical inclusion bodies in section.)

Results of this experiment are shown in Table C.

TABLE C.

Group	No. of turkey chicks	Age	Immunising Material	Method of application	Reaction	Mortality	Interval after vaccination when tested on immunity	Result	Controls
1	2	One day	Fowl-pox live virus	Very light scarification on thigh	Good	Nil	One chick from each group tested approx. at 8 weeks	Nil	Fairly good
2	2	Five days	Fowl-pox live virus	Very light scarification on thigh	Good	Nil	One chick from each group tested approx. at 3 months	Follicles swollen Very little scab	Follicles swollen with fairly good scab

Turkey chicks under a week old can be successfully vaccinated with fowl-pox virus without mortality.

The immunity conferred does not appear to be complete against artificial infection three months after vaccination.

Experiment 5.

To compare : (1) the difference, if any, between fowl-pox virus and pigeon-pox virus with regard to vaccination and immunity conferred on chicks under a week old; (2) the difference, if any, between the application of the above viruses to a plucked surface only and to a plucked and lightly scarified surface of the thigh.

Sixteen day-old chicks were separated into four groups and vaccinated as follows :—

Group 1.—4 day-old chicks had live fowl-pox virus applied to a small plucked and lightly scarified area on the left thigh.

Group 2.—4 day-old chicks had live fowl-pox virus applied to only a small plucked area on the left thigh.

Group 3.—4 day-old chicks had live pigeon-pox virus applied to a small plucked and lightly scarified area on the left thigh.

Group 4.—4 day-old chicks had live pigeon-pox virus applied to only a plucked area on the left thigh.

Approximately six weeks later all four groups were fairly heavily scarified on the right thigh and tested on their immunity with live fowl-pox virus.

The pigeon-pox virus used in this experiment was a 2 per cent emulsion of powdered scabs in liquid paraffin; the scabs were obtained from the breasts of reacting pigeons as previously described. No attempt was made to exalt the virulence of this virus for fowls by passage through susceptible fowls. (It is hoped that at a later date this experiment may be repeated, using pigeon-pox virus of exalted virulency.)

The results of this experiment are shown in Table D.

TABLE D

Group	1	2	3	4
No. of chicks	4	4	4	4
Age	One day old	One day old	One day old	One day old
Identification mark	Picric stain	Violet stain	Blue stain	Red stain
Preparation of area for vaccination	Plucked and scarified	Plucked	Plucked and scarified	Plucked
Immunising material	Fowl-pox virus (live)	Fowl-pox virus (live)	Pigeon-pox virus (live)	Pigeon-pox virus (live)
Reaction	++++	+++	+	+
Mortality	Nil	Nil	Nil	Nil
Interval before tested on immunity	6 weeks	6 weeks	6 weeks	6 weeks
Result	Nil	One follicle swollen	Follicles swollen and scab formed	Follicles swollen and scab formed

++++ = very good reaction. +++ = good reaction, not so severe as above.
+ = very poor reaction.

There is apparently no doubt that the immunity produced through vaccination with fowl-pox virus is of an appreciably higher standard than that produced by pigeon-pox virus, which was of an extremely low standard.

The only difference in the methods of application of the virus seemed to be a slightly delayed and not quite so severe reaction in the cases where the area was only plucked and not scarified.

Conclusions.

(1) Young chicks from one to eight days old can be successfully vaccinated with live fowl-pox virus and immunized against fowl-pox.

(2) Occasionally there is apparently a risk of generalization and mortality after vaccination.

(3) The immunity produced does not, in the majority of cases, protect against retest with live virus after two months, although it is probably efficacious against natural infection beyond that period.

(4) That, although there is less risk of mortality, pigeon-pox virus in the unexalted state gives very little protection against retest with live fowl-pox virus.

Remarks.

It is not considered advisable to vaccinate chicks under a month old with live fowl-pox virus, unless in exceptional cases where considerable mortality may be expected to occur from some heavy outbreak of the disease. The risk of mortality from vaccination through generalization of the infection is a factor which must be considered. However, it is probable that this factor might be considerably reduced by adopting the method of applying the vaccine to a small plucked but unscarified area of the skin. This method should be adopted in cases where day-old chicks are concerned when vaccination is considered necessary.

Vaccination with live pigeon-pox (unexalted) was apparently unsuccessful, but further experiments are necessary with exalted virus. (Doyle, 1930.)

COCCIDIOSIS IN BIRDS.

By J. R. Hudson.

Eimeria pfeifferi, Labbé.—On 6-5-30, two young tame pigeons were obtained from a native at Kabete, to find out if coccidia were prevalent in this species in Kenya. The birds appeared to be healthy, and were free from *Lynchia*.

A small quantity of droppings from the birds was emulsified in water and centrifuged. The supernatant fluid was poured off gently, and the tubes were filled up to the top with a saturated solution of salt. After placing a small coverslip over the mouth of the tubes, so as to exclude air-bubbles, the tubes were recentrifuged. Examination of the coverslips after removal revealed a very heavy infection with coccidia.

On measurement, the oocysts were found to vary from 23 to 17 microns in length and from 17 to 15 microns in breadth, the average size being 19.3 microns by 16.5 microns. The oocysts were round-oval to spherical in shape, there being little difference in the two ends. There was no visible micropyle, nor was a residual body left on the formation of the sporocysts. The oocysts therefore resemble those originally described by Labbé as *Eimeria pfeifferi*.

The coverslip preparation was placed in a watch-glass of water, covered with a Petri dish, and examined at intervals. At the time of preparation, the cytoplasm had a greenish, vaguely granular appearance and almost filled the oocyst. Twenty-four hours later it had begun to contract, leaving a clear, moon-shaped space at one end. The granular cytoplasm appeared to be condensing into smaller, more defined granules.

Forty-eight hours after preparation, the cytoplasm of many of the oocysts was free from the wall all round and circular in shape. The granules had shrunk into small green points.

On the following day a few oocysts showed four distinct sporocysts, and after another twenty-four hours most of the oocysts had reached this stage. The formation of sporozoites takes place rapidly. In an individual oocyst it was followed for four hours, at the end of which time the process was almost completed.

Leblois (1921) states that although usually innocuous, this parasite has been associated with large epiornithics in young pigeons. The disease is characterized by diarrhoea and nervous symptoms. Mortality may be as high as 40 per cent.

Eimeria tenella, Railliet and Lucet, and *E. maxima*, Tyzzer.—A severe outbreak of coccidiosis in young chicks occurred during the year on a farm near Naro Moru. The owner reported that he had lost 50 per cent of his young birds. A few of the chicks died at as early an age as four days; but

most of the deaths took place about the twelfth day. The chicks were hatched in incubators and reared in a modern type of brooder. When they were old enough, they were put into houses with concrete floors. The concrete floors were covered with sand and were cleaned out once a week. The chicks were fed on a balanced ration, which included sour milk. The birds were in such poor condition that their wings appeared abnormally large compared with the size of their bodies.

On post-mortem examination, the chicks showed no characteristic enteritis in the cæca. The cæca were, however, impacted and distended by a hard grey mass of material which, when rubbed down with water on a slide, was found to consist almost entirely of oocysts. No other lesions were present, though, in spite of starvation treatment for three days after hatching, the yolk-sac was not absorbed.

Tyzzer (1929) has recently revised the coccidia of poultry. Most of the oocysts found in this outbreak agreed in size with his measurements of *Eimeria tenella*. A few large oocysts of the dimensions of *E. maxima* were also present.

Examination of the fæces of a single hen from this farm revealed a very heavy infection with coccidia, and there was no doubt that the older birds were the source of infection for the chicks.

Eimeria acervulina, Tyzzer.—This species, which, unlike *E. tenella*, invades the duodenal mucosa, has been encountered once during the year in an imported cock. The parasite produced a very severe anæmia.

Of the four species described from the domestic fowl by Tyzzer, only *Eimeria mitis* remains to be recorded from Kenya.

Eimeria meleagridis, Tyzzer (1927).—Oocysts, agreeing in all respects with those of this species, were recovered from the cæcal contents of a young turkey. The bird was one of several reported to have died at the same age and with similar symptoms.

The lesions found post mortem resembled those found in the outbreak in young chicks described above, although the mass impacting the cæcum was not so hard. The oocysts were all about the same size, measuring 23.1 microns by 16 microns on the average.

References.

Leblois, 1921 : *Sur le coccidiose du pigeon.* Rec. Med. Vet., p. 450.

Tyzzer, E., 1929 : *Coccidiosis in Gallinaceous Birds.* Amer. Jour. Hyg. X, p. 269.

PLANT POISONING.

By J. R. Hudson.

A few local plants have been fed to sheep during the year. With the exception of two, which were tried late in December and which have not yet been identified as it has not been possible to obtain flowers, none can be described as poisonous. The plants and amounts given are tabulated for future reference :—

Species	Part of Plant	How Given	Dose	Remarks
Trifolium semipilosum (a native clover.)	Stem, leaves and flowers.	Fed over two days.	1595 grms. of fresh plant.	Eaten greedily by young weaner 3529. No hoven or other symptoms.
Ornithogalum longibracteum (wild onion).	Whole non-flowering plant.	Drenched.	50 grms. of dry plant. This represents about ten complete plants with bulbs.	No diarrhoea or other symptoms.
Ditto.	Flowering plant without bulbs.	Drenched with aqueous extract after mincing, followed after three days by minced plant.	400 grms. fresh plant.	No symptoms.
Hypoxis villosa.	Tubers.	Drenched with thick suspension dried ground roots in water and sodium chloride.	266 grms. given as 133 grms. on successive days.	Caused scouring, but no signs of abdominal pain or decrease in appetite.
Ditto.	Leaves and flowers from tubers as above.	Drenched with thick suspension dried ground plant in water and sodium chloride.	20 grms. given in one dose.	Caused a little scouring on the following day. No signs of abdominal pain.
Ditto.	Tubers.	Inoculated with extract in 75 per cent alcohol.	10 c.c. subcutaneously one day, followed by 10 c.c. intravenously the following day. The alcohol was then removed by distillation at a reduced pressure and 10 c.c. of concentrated extract given on the next day intravenously.	The intravenous inoculation of 10 c.c. alcoholic extract was followed by drowsiness, tympany and spasms in the popliteal muscles. This was apparently due to the alcohol as the concentrated extract on the last day produced no symptoms.

REPORT ON TICK SURVEY IN KENYA COLONY.

By E. Aneurin Lewis, *M.Sc.*, *Ph.D.*

I arrived in the Colony on first appointment on the 9th May, 1930. Stationed at the Veterinary Research Laboratory, Kabete, I proceeded to trace out the history of tick investigations in Kenya Colony, and thus form a foundation for further investigations. I have been able to gather together much valuable information, which was only obtainable by the perusal of much scattered literature. As some references are, at present, still inaccessible to me, it does not seem advisable to publish this historical review until a further date. Nevertheless it may be stated that our knowledge of the ticks and tick-borne diseases in Kenya Colony has progressed satisfactorily. In 1909, the ticks known in the Colony were *Ornithodoros moubata, Amblyomma gemma, A. lepidum, A. marmoreum, A. personatum, A. petersi, A. variegatum, A. hebræum, Ixodes rasus, Hæmaphysalis leachi, Rhipicephalus appendiculatus, R. exinctus* (now *R. maculatus*), *R. evertsi, R. oculatus, R. pulchellus, R. sanguineus,* and *R. simus.* The tick-borne diseases known at the time were East Coast fever, and redwater or Texas fever in cattle; biliary fever or piroplasmosis in horses; biliary fever in dogs; and heartwater in sheep and goats.

Since 1909, several attempts have been made to carry out a survey of the pathogenic and non-pathogenic ticks of the Colony; these were abandoned, no doubt due to the pressure of work of more urgent a character.

The following table shows the various species and varieties of ticks which, up to the present, have been collected in Kenya. The names of hosts, the localities, and the date of collection are available, and will be utilized when a more complete survey will have been carried out.

GENUS	*AMBLYOMMA.*	*APONOMMA.*	*ARGAS.*	*BOOPHILUS.*	*DERMACENTOR.*
SPECIES	*A. eburneum.* *A. gemma.* *A. hebræum.* *A. lepidum.* *A. marmoreum.* *A. personatum.* *A. petersi.* *A. splendidum.* *A. tholloni.* *A. variegatum.*	*A. læve.*	*A. persicus.*	*B. decoloratus.*	*D. rhinocerotis.*
VARIETY					

GENUS	*HÆMAPHYSALIS.*	*HYALOMMA.*	*IXODES.*	*ORNITHODOROS.*	*RHIPICEPHALUS.*
SPECIES	*H. aciculifer.* *H. bispinosa.* *H. calcarata.* *H. leachi.* *H. parmata.*	*H. ægyptium.*	*I. cavipalpus.* *I. nairobiensis.* *I. pilosus.* *I. rasus.* *I. rubicundus.* *I. schillingsi.*	*O. moubata.* *O. savignyi.*	*R. appendiculatus.* *R. armatus.* *R. bursa.* *R. capensis.* *R. evertsi.* *R. falcatus.* *R. kochi.* *R. maculatus.* *R. neavei.* *R. nitens.* *R. oculatus.* *R. parvus.* *R. pulchellus.* *R. sanguineus.* *R. simus.* *R. supertritus.*
VARIETY	*H. ægyptium impressum.* *H. ægyptium dromedarii.*				*R. simus* var. *lunulatus.*

The genera represented and the number of species belonging to each genus is: *Amblyomma*, 10; *Aponomma*, 1; *Argas*, 1; *Boophilus*, 1; *Dermacentor*, 1; *Hæmaphysalis*, 5; *Hyalomma*, 1 species, 2 varieties; *Ixodes*, 6; *Ornithodoros*, 2; and *Rhipicephalus*, 16 species, 1 variety.

Of those listed in the above table, the following are believed to be recorded for the first time as occurring in Kenya Colony :—

Parasites	Hosts	Locality
Amblyomma eburneum ..	Buffalo, rhinoceros.	Northern Frontier District
Amblyomma splendidum	Eland	Blue Plains, Southern Masai Reserve
Aponomma laeve ..	Snake	Blue Plains and Laikipia
Haemaphysalis aciculifer	Hare, Water-buck, Buffalo ..	Karati Forest
	Bush-buck ..	Limuru
Haemaphysalis calcarata	Dog	Naivasha
Hyalomma aegyptium impressum	Cattle, ostrich, zebra, roan, oryx, reed-buck and eland	Generally distributed
Hyalomma aegyptium dromedarii	Cattle ..	Kedong Valley, Blue Plains, Southern Masai Reserve
	Eland ..	
Ixodes cavipalpus ..	Hare	Naivasha
Ixodes rubicundus ..	Grant's Gazelle	Blue Plains, Southern Masai Reserve
Rhipicephalus simus lunulatus.	Wild dog ..	Benani, N.F.D.

It has been observed that many known pathogenic ticks occur frequently on game, and therefore it may be stated that game undoubtedly contributes to some extent to the distribution of ticks throughout some parts of the Colony. It may be of interest to note also that eleven species occur equally common on domestic animals and on game; twenty-two species on wild animals only; thirteen species on domestic animals only; and two species on man. *Amblyomma petersi*, *A. variegatum*, *Rhipicephalus appendiculatus*, *R. maculatus*, *R. pulchellus*, and *R. simus* have been collected also from grass.

It is clear that the genus *Rhipicephalus* predominates in this Colony. Neumann (1896) and Warburton (1912) consider this genus as essentially African. Not only are the species numerous but the members of the species occur in abundant numbers. The most common forms, which are also

known to be of great economic importance, are *R. appendiculatus*, the common brown tick, and *R. evertsi*, the red-legged tick. *R. pulchellus*, which is exceedingly common on the Athi and the Kapiti Plains, does not appear to have been inculpated in the transmission of disease, though, according to Montgomery (1912), it abounds near and in an infected (East Coast fever) area near the Athi River. *R. simus*, the black-pitted tick, is by no means uncommon. It has been proved to be capable of transmitting East Coast fever. This species I have found on the Athi Plains—open country, and also in shaded woodlands. It also presents an interesting range of varying characters, which I hope to be able to study when the opportunity arises.

Not only is the genus *Rhipicephalus* of economic importance; it offers an interesting problem to the systematists. Individuals of one species vary so widely that they may easily be mistaken for individuals belonging to another species. Warburton (1912), after having examined many thousands of *Rhipicephalus* collected from all parts of Africa, concluded that the genus was in an extremely fluid condition, and that there appeared to be a considerable number of species "in the making." It is evident therefore that this genus in particular needs careful study.

The genus *Amblyomma* is important also; at least, in so far as *A. variegatum* has been proved to be the chief vector in the transmission of heartwater to cattle, sheep and goats. The lesions caused by the bites of Amblyomma ticks must affect, directly or indirectly, the health of animals infested. The hide, perforated by these ticks, is also much depreciated in value.

There seems to be some confusion as to the occurrence in Kenya of *Amblyomma hebræum*, the chief transmitter of heartwater in South Africa. Neumann (1899) refers to a female *A. hebræum*, in the Smithsonian Institute, which was collected in the neighbourhood of the Tana River. Howard (1908) records it from British East Africa, but he does not state whether it was collected in Uganda or Kenya. Neave (1911) mentions *A. variegatum* and *A. hebræum* as being the most common parasites on horses and cattle; Anderson (1924) lists *A. hebræum* from cattle; and Daubney (1930) states that particular attention was directed to a search for this species since 1925, with no success.

Among a number of ticks in the museum of the Veterinary Research Laboratory, Kabete, I have identified one engorged female, three males, three nymphs and four larvæ which undoubtedly belong to the species *A. hebræum*, but as no data concerning these specimens are available, they cannot be accepted as a definite record that they were collected in Kenya. Of the large number of *Amblyomma* which I have received and collected, I have not found a single specimen of *A. hebræum*. The only authentic record seems to be that referred to by Neumann.

In view of the fact that *A. gemma* is exceedingly common and resembles in some ways *A. variegatum* and *A. hebræum*, it is not unreasonable to suggest that *A. gemma* may have been mistaken for *A. hebræum*.

Nymphal stages of *A. variegatum* and *A. gemma* have been collected in large numbers. Only on two occasions have I been able to find the larval forms. One larva of *A. variegatum* was obtained from the hind leg of a bullock at Mgwani, and two larvæ of the same species were obtained from the neck of a reed-buck at Sangalo.

The genus *Ixodes* does not seem to be represented by species which are known to be of economic importance in this Colony. The occurrence of *Ixodes pilosus*, the sheep paralysis tick, or the russet tick of South Africa, may prove to be more widely spread than is known at present. It has been recorded from the Colony on six occasions, out of which five refer to its occurrence on the serval cat (*Felis capensis hindei*). Daubney (1925) records it from sheep and dog. I have collected specimens from a bush-buck in the Limuru district.

I have been informed that a record of *Argas persicus* on fowls refers to specimens collected at Mombasa some time previous to 1924. It is of interest therefore that the next record should be for a place so far inland as the Ngong Valley. I have received numerous specimens from a fowl-house in this locality. Probably this tick is also more prevalent than is indicated by the records, or it may be that this is merely a case which has become infested by the introduction of infected birds brought from the Coast.

The genus *Boophilus* is represented by one species, *B. decoloratus*, the blue tick. In spite of the fact that this tick is believed to be a common pest, I have received and collected specimens from comparatively few districts. Further experience along with more extensive field work may prove this tick to be very common.

Hæmaphysalis leachi, the dog tick, is the most common parasite of its genus. There is hardly any doubt that it is the chief vector of biliary fever or piroplasmosis of the dog. It occurs in abundant numbers in the Colony, whereas the European dog tick, *Rhipicephalus sanguineus*, not very common in Kenya, plays a role in the transmission of the disease second to *H. leachi*.

Hyalomma ægyptium and *H. ægyptium impressum* occur on a number of animals. The ostrich seems a favourite host. These ticks cause serious harm to stock by biting deeply through the skin and giving rise to sores, abscesses and ulcers. It is not uncommon to see them completely buried in wart-like abscesses. In this country and others their presence is often associated with ulcerative and epizootic lymphangitis.

The tick-borne diseases recognized in Kenya Colony today are : East Coast fever, redwater or Texas fever, anaplasmosis (genuine gallsickness), theileriasis (caused by the protozoan, *Theileria mutans*), and spirochætosis in cattle ; heartwater in cattle, sheep and goats ; biliary fever or piroplasmosis, and spirochætosis in horses, mules and donkeys ; and Nairobi sheep disease or gastro-enteritis of sheep. Relapsing fever in man occurs in some districts. Although the fowl tick has been recorded, there seems to be no evidence of the presence of spirochætosis which is transmitted to these birds by this particular tick.

Laboratory Work.

Experiments carried out in the Laboratory include some investigations on the biology of ticks. The results of these experiments are not fully ripe for publication, and it would lead to erroneous impressions if the fragmentary evidence now available were made public. It is hoped that a comprehensive and complete report will be published later.

The life-cycles of *Rhipicephalus appendiculatus* (a three-host tick) and *R. evertsi* are being repeated for purposes of comparison, and in order to observe possible peculiarities which may throw some light on the importance of *R. evertsi* as a vector of East Coast fever. The rearing of various stages of *Hæmaphysalis leachi* and *Boophilus decoloratus* is being kept up continuously in order to supply material for any experiments on the transmission of tick-borne diseases. The longevity of each stage of different ticks is being tested under varying conditions of temperature and moisture. A number of ticks

have been forwarded to the Laboratory for identification. These have been dealt with, and ticks which are continually coming in are being classified and preserved.

I have solicited the aid of other departments and lay persons in this survey work, and I wish to record my gratitude to Mr. Pat Ayre, the Game Warden and his staff, the Hon. the Chief Veterinary Officer and his field officers, for the valuable support they have given to this problem of tick survey.

Field Work.

A.—Nyanza Province.

A preliminary investigation was carried out in some parts of the Nyanza Province in October, 1930.

The native (Kavirondo) stock were carefully examined, and some considerable time was spent in "dragging" the ground for ticks. The nature of the soil and vegetation were studied; the altitude and general topographical features were noted; the type of country and the general geographical situations were carefully considered; and attention was paid also to the treatment of stock by the natives, and the methods employed by them to deal with tick infestation.

Visits were made from the Veterinary Training Centre at Maseno to Sakwa, Sangalo, South Tereki, and Sagam, and a search for ticks was made along the Maseno–Yala–Mumias Road to Sangalo.

The ticks collected during this *safari* were *R. appendiculatus*, *R. simus*, *A. variegatum*, *A. gemma*, *H. leachi*, and *B. decoloratus*. The individuals of the species were very numerous. Adults and nymphæ were abundant, the larval forms rare. Two larvæ of *A. variegatum* were collected from a reedbuck at Sangalo, and a few nymphæ of *R. appendiculatus* were collected from a duiker at Sagam.

It was observed that there was a great paucity of game in these districts, and it must be concluded therefore that in this case game cannot be held responsible for the distribution of ticks. The wandering herds of native cattle may contribute to the distribution. It was not possible to examine vermin, and no facilities were available to examine many birds.

The most common bird and apparently the most numerous was a certain species of hawk, some of which were captured and examined for ticks, particularly the larval stage of *A. variegatum*, a tick occurring abundantly at Maseno. No larvæ were found.

As a result of "dragging," *R. appendiculatus*, *R. simus*, *A. variegatum* and *H. leachi* were obtained from grass and bush. With the exception of *R. simus*, which, in this case, was found in the shady woodlands only, these ticks were collected in open country. *B. decoloratus* was rare; two nymphæ only were collected from a calf.

Considering the fact that the areas visited are "dirty," and that no dipping is practised, it may be said that the cattle are surprisingly free from ticks. The majority of ticks collected were found in the ears and less frequently between the hind legs.

This state of affairs seems to be due to the habit among the Kavirondo natives of hand-picking the ticks. They seem to neglect the ears, however.

B.—Rift Valley.

For some considerable period it has been claimed that there exist in the Rift Valley and the adjacent districts, one or more conditions of nature which tend to check the spread of the vecting tick of East Coast fever or of the disease itself. Stordy (1912) demonstrated that ticks accountable for the propagation of East Coast fever, as well as some other varieties of ticks, complete their life-cycles and generate their species in the lavic soil of the Rift Valley. In 1913 one case of infection (East Coast fever) was probably traceable to an experimental paddock erected in the previous year, and in which East Coast fever experiments were carried out.

In spite of this, however, the belief persists that some elemental influence, extant in the Rift Valley and adjacent country, is inimical to the tick or to the disease.

It was therefore decided to investigate the problem in these particular districts from another point of view, namely by a tick survey and a study of natural conditions.

The examination of the ticks and the data collected during this investigation of over five weeks is not yet completed. Some interesting features have already come to light. The results, however, cannot be considered as conclusive.

The following table shows the variety of ticks collected on the Kinangop Plateau, the Karati Forest and the Mara Guishu Plains :—

DISTRICT SURVEYED						Diseases Transmissible by Tick
KINANGOP		KARATI FOREST		MARA GUISHU		
Tick	Host	Tick	Host	Tick	Host	
Boophilus decoloratus (blue tick).	Cattle.	..	..	..	..	Redwater, Anaplasmosis.
Rhipicephalus bursa.	Cattle, dog and off grass.	*R. bursa* ..	Goat.	*R. bursa.* ..	Goat, sheep and waterbuck.	
Rhipicephalus evertsi (red-legged tick).	Cattle.	*R. evertsi* ..	Buffalo.	*R. evertsi* ..	Sheep and goat.	E.C.F. and biliary fever to horses.
Hæmaphysalis leachi (dog tick)	Dog.	*H. leachi* ..	Dog.	..	..	Tick fever to dogs.
		Rhipicephalus appendiculatus (the common brown tick).	Buffalo and waterbuck.	*R. appendiculatus*	Sheep.	East Coast fever.
		Rhip. neavei var. punctatus.	Cattle.	*Rhip. neavei* var. *punctatus.*	Hare.	Nil.
		Rhip. capensis ..	Buffalo.			
		Rhip. simus (black-pitted tick).	Buffalo.	..	..	East Coast fever.
		Ixodes pilosus ..	Bushbuck	..	..	Paralysis to sheep
		Hæmaphysalis aciculifer	Waterbuck and bushbuck.	*Ixodes cavipalpus*	Hare.	
				H aciculifer ..	Waterbuck and hare.	
		Hyalomma ægyptium impressum	Buffalo.	*Hy. ægyptium impressum* ..	Goat.	

The Kinangop Plateau is at an altitude of 8,300 to 8,500 feet. On the west it is bounded by the Aberdares, and on the eastern side the escarpment represents a drop from 8,300 feet to 7,200 feet through the Karati Forest to 6,900 feet at the Mara Guishu Plains, reaching 6,230 feet at Naivasha.

The Plateau presents large areas of black cotton soil, where the removal of bases and consequently humus has proceeded to such an extent that the surface soil is white or grey in colour. Other areas towards the Aberdares and on the intervening ridges consist of red soil. The Karati Forest slopes also are of a red soil type, but the majority of the Mara Guishu soil is of a black cotton type. The vegetation on the high plateau consists of extensive areas of the coarse and tufted *Eleusine indica* (the tussock grass), and similarly the Mara Guishu. These areas are said to be the result of heavy grazing by the Masai in years gone by. The pastures of the Karati Forest comprise the smaller and larger sheltered glades.

It is understood also that periodic frosts occur on the Kinangop particularly about January and July. One has experienced the strong dry winds on the plateau; and no doubt the black cotton areas of the Plains (Kinangop and Mara Guishu) become waterlogged during the heavy rains. Dipping is carried out at some of the farms. It does not seem to be a regular practice, however. Fencing and paddocking have not progressed a great deal, and there exists a certain degree of antipathy to the control or the eradication of certain ticks (e.g. the blue tick).

A study of the above table and notes suggests that, in these districts, soil does not have a direct influence on the incidence of ticks. If one compares the area of black cotton soil on the Kinangop and that of the Mara Guishu, for instance, it will be found that *Rhipicephalus appendiculatus*, *Rhipicephalus neavei* var. *punctatus* do not seem to occur on the former, whereas they do on the latter. Furthermore, as the Kinangop comprises black cotton and red soil, and, on the other hand, the Mara Guishu comprises the one type only and the Karati Forest the other, one would expect most of the ticks of both Mara Guishu and Karati Forest to occur on the Kinangop. This is obviously not so. This, however, does not eliminate the possibility of the soil acting as an indirect influence on the incidence of ticks. It is necessary to investigate other areas and possibly to carry out experiments in the field, to obtain conclusive results.

A larger variety of ticks were found in the shelter of the Karati Forest than on the Plains. This may indicate the favourable influence of shade or shelter on the ticks. Also various game have their haunts in this Forest and account for the number of species, as is clearly shown in the table. Experience in the field shows that more ticks are collected from sheltered spots than from those exposed to sun and dry winds.

In brief, the altitude, along with the occasional frosts and open country, seems to account for the non-existence of certain species of ticks in these districts. The common brown tick, for instance, may live under these conditions, but it may not develop and thrive. On the other hand, the blue tick, the red-legged tick, *Rhipicephalus bursa*, and some few others can withstand periods of adverse conditions. This last may account for the seasonal variations in degree of infestation of stock by ticks.

This points out also the necessity for more stringent methods than are practised at present in this district. Indeed, there is grave danger that in such places as these, where ticks and diseases are normally rare, neglect of precautions may produce serious results and fresh field for disease in the future. Fencing and dipping, along with hand-dressing, would be justified in a comparatively short period of time.

It is intended to make a more exhaustive report very shortly, but it may be stated that this investigation has shown beyond doubt that eradication of ticks is a practicable proposition.

Cases have been met with where farms in scheduled " dirty " areas have reduced the ticks to practically nil. It has proved that squatter cattle may hinder the eradication of ticks, and it has shown that the migration of Somali stock has, in the past, contaminated the land in certain districts.

It has brought forcibly to mind the necessity for a co-operative effort to eradicate ticks and consequently tick-borne diseases by little more than strict scientific and practical farming.

Other Investigations.

On the departure from the Colony of Dr. Ham, of the University of Washington, I was requested to assist Dr. E. V. Cowdry in the investigation into the life-cycle of *Theileria parva* in the tick *R. appendiculatus*. During the months of July and August my time was occupied in rendering assistance in this investigation.

Specimens of blood-sucking insects have been received from the field and have been identified as follows :—

Hæmatopinus eurysternus (cattle louse), from Mombasa and Lamu.

Hippobosca capensis, from lion, cheetah and Grant's gazelle, South Masai Reserve.

Hippobosca maculata, from camels, Northern Frontier District.

Tabanus sufis, *Tabanus ustus*, *Tabanus albipalpus*, *Tabanus biguttatus*, from N.F.D. and Lamu.

Glossina longipenis (tsetse-fly), from Buna, N.F.D.

Glossina brevipalpis (tsetse-fly), from Buna, N.F.D.

Glossina palpalis (tsetse-fly), from South Kavirondo.

Stomoxys calcitrans, from Laikipia and Mombasa.

Stomoxys nigra, from N.F.D.

Lipoptena cervi, from Grant's gazelle, South Masai Reserve.

The prevalence of trypanosomiasis in certain districts of the Colony seems to point to the necessity for further research, experimental and field-work, into the vecting blood-sucking insects which are reputed to be possible mechanical or biological transmitters of this disease.

An investigation into the period occupied by *Psoroptes communis* var. *ovis*, the sheep-scab mite, to complete its life-cycle in Kenya Colony is now in progress.

In conclusion, I submit that further assistance to carry out the work involved in a tick survey of the Colony will be necessary in the near future. The problem calls for extensive and continuous research in the field and a great deal of experimental work in the laboratory.

It is essential to examine domestic and wild animals for ticks in various stages of development. Nymphal stages, in particular, should be kept under observation for possible parasitic insects. "Dragging" the land with suitable nets will undoubtedly prove valuable in the search for ticks and the elucidation of their habits. It is imperative to study the type of country, the nature of soil and vegetation, the altitude, natural watersheds and drainage, and also to take into consideration the methods adopted to eradicate ticks. Unfortunately, financial difficulties and the lack of suitable maps have not permitted me to carry out the work according to the programme arranged.

HORSE-SICKNESS.

Prophylactic Vaccination Experiments.

In the Annual Report of the Department for 1929 are recorded the results of experiments carried out during that year and up to and including March, 1930.

Experiments have been continued at the Laboratory during the year and, where possible, opportunities have been taken of carrying out experimental inoculations in the field, using variations of methods previously employed. These field observations have been carried out in conjunction with similar experiments on a small scale at the Laboratory.

During the year, vaccine as a field service was asked for, and, as a result of observations made during the previous year, a formalized spleen-tissue extract was issued, the amount of formalin added being in the proportion of formalin 1 part to every 500 parts of the mixture, the whole being stored at ice-box temperature during preparation and subsequently.

It proved, however, that material treated in this way, and prepared with the apparatus at our disposal, was not rendered inactive within a period of twelve days. Experiments carried out during 1929 indicated that vaccine so treated was completely inactivated within twelve days, but in these experiments only small amounts of material were handled; the preparation of vaccine in bulk proved a more difficult procedure. As a precautionary measure therefore all vaccines for issue to the field were tested as to their safety on three occasions at the Laboratory prior to despatch. This necessitated the use of horses which might otherwise have been used for experimental observations at the Laboratory, and also was responsible on various occasions for considerable delay in the issue of vaccine for field inoculations. It resulted also in the use of vaccine which had of necessity been stored for some considerable time awaiting the results of the preliminary safety tests. Later in the year, the method of preparation was altered, in that the vaccine was made to contain one part of formalin to every 300 or 400 parts of the mixture. Inactivation of the virus was thereby hastened, and more freshly prepared vaccines were available for issue.

On reference to the accompanying tabulated sheets, it will be noted that horses have been used for experiments after having been used for testing the safety of some particular

vaccine; or such a test inoculation has been included in the experiment. Owing to the shortage of experimental animals this was unavoidable.

In conjunction with the text of this report, reference should be made to the details given in the tabulated sheets which are attached. In order to save space, full details have been omitted where possible, e.g. inoculations of horses 1321 to 1338 inclusive.

Spleen Vaccine: Can it produce a complete "block-out" to infection, using large doses of vaccine?

As will be seen from the records, the value of spleen-tissue extract as an immunizing agent has been confirmed. It was considered probable, however, that although the inoculation of inactivated vaccine could produce a state of resistance in an animal sufficient to protect against the development of any visible symptoms when subsequently inoculated with a large dose of infected blood or other virus, the blood of a vaccinated horse, collected at some period during the immunity test, say seven to ten days after the inoculation of virulent blood, would prove virulent on inoculation to horse-sickness-susceptible equines. In other words, it was desired to prove whether or not inactivated spleen-tissue extract produced a complete "block-out" to a large dose of virulent blood, with subsequent susceptibility of the inoculated horse. It was hoped to carry out the complete experiment on a number of horses, but it was subsequently found impossible to obtain horses for the sub-inoculations of blood collected from horses on immunity test.

In all, eighteen horses (*see* tabulated sheets Nos. 1321 to 1338 inclusive) were inoculated with inactivated vaccine, varying in individual cases from three to ten inoculations. Unfortunately, the different lots of vaccine used had been stored in some instances for some time—up to three months—since it was found impossible to prepare fresh vaccine as required, no susceptible equines being available for the purpose. Each horse was subsequently tested on its immunity by inoculation of known virulent material, and the number of such tests made varied in individual cases from one to nine over a period of nine weeks.

It will be noted that only two animals showed temperature reactions to immunity tests, and these were young foals. Absorption of vaccine in foals appears to be slow and, indeed, in some cases very little of the vaccine becomes absorbed,

owing to early abscess formation. The vaccine used generally was stored thirty days in the ice-chest prior to use, and, in some instances, vaccine two or three months old was used. This serves to show that vaccine stored for some time is of value, at any rate when used in repeated inoculations. The majority of the horses in the experiment were country-breds, and included an imported Arab stallion. Sub-inoculations were carried out in two instances only. The results may be indicated as follows :—

Horse No. 1326 (country-bred thoroughbred) was first tested on its immunity by inoculation of virulent material on 20-2-30. Blood from this equine was drawn on 28-2-30, i.e. eight days after the test inoculation, and 100 c.c. of this fresh blood inoculated directly into Horse 1339, with the result that Horse 1339 reacted and died of horse-sickness on the seventh day after inoculation.

Horse No. 1331 (country-bred thoroughbred) was first tested on its immunity by inoculation of virulent material on 21-3-30. Blood from this horse was drawn on 31-3-30, i.e. ten days after the immunity test inoculation, and 10 c.c. of this fresh blood inoculated directly into Horse 1340. Result : Horse 1340 reacted and died of horse-sickness on the sixth day after inoculation.

These results show that, with the inactivated spleen-tissue extract used, the subsequent inoculation of a large dose of virulent virus gives rise to a reaction without visible symptoms, and the writer is of the opinion that a reaction of some sort will occur in all cases so treated. No experiments have been carried out to determine the results of inoculation of very small doses of virulent virus, or an attenuated virus; but in subsequent experiments it will be seen that there is some reason to suspect that spleen or blood vaccine, or a mixture of both, may completely " block-out " a reaction to the inoculation of other than large doses of virulent virus.

The majority of the horses in the above-mentioned experiment were privately owned, and were returned to their owners for exposure to nature infection. So far as was known, there were no cases of horse-sickness amongst the different lots during the year.

Immunization by combination of Vaccine and Virus Method.

From the results recorded above, the possibility has been considered of actively immunizing horses by inoculating with inactivated vaccine in such a manner as to protect against any

visible symptoms, or other untoward *sequelæ*, on the subsequent inoculation of a virulent or an attenuated virus, provided of course that the virus inoculation did produce some reaction, even though an invisible one, so to speak, with a good immunity.

A difficulty which has been recorded in the application of any method of immunization in which virus is inoculated, is that a reaction to inoculation may have a more or less permanent untoward effect on the constitution of the inoculated horse. If the reaction can be reduced in severity to a degree in which no symptoms whatever are observed, and this in 100 per cent of cases, it would seem that a method of immunization producing such results would be of great value. A vaccine-virus method, as already indicated, might produce these results, and our observations to date in this direction are encouraging. A number of horses so treated have been exposed to natural infection in various districts of the Colony with, as yet, no reports of fatal cases of horse-sickness infection in the exposed horses. Irregular temperature reactions, but with no mortality, have been reported in four cases amongst exposed horses, and these reactions may have been due to horse-sickness infection.

Strains of Virus.

The fact that there are different strains of horse-sickness virus complicates the process of immunization. Horses immune to one strain of virus are not necessarily immune to another individual strain (*see* Horses Nos. 1296 and 1297); and, indeed, horses immune to a particular generation of a strain of virus may prove susceptible to another generation of the same strain. Such a factor may have been responsible for the death of Horse No. 1356 (*see* tabulated sheets).

Opportunity has been taken where possible to collect horse-sickness virus from cases of the disease in the Colony, and to pass the strains obtained through horses at Kabete. An interesting fact is that, of two horses vaccinated, and tested on their immunity by inoculation of virulent blood (" O " strain of virus) each week until eighteen such tests had been carried out on each horse, both reacted and died of horse-sickness on the nineteenth test with a strain of virus obtained from Molo. (*See* Horses Nos. 1296 and 1297). Several other vaccinated horses, when tested with this strain of virus, did not react.

On the other hand, blood from a typical clinical case of horse-sickness at Ulu, failed to produce a reaction in a horse (*see* No. 1362) at the Laboratory, yet when this horse was inoculated with " O " virus a month later it reacted and died of the disease after a typical acute reaction.

Strains of virus collected at Kikuyu and Lower Kabete both produced fatal reactions on inoculation to horses at the Laboratory (*see* Horses No. 1365 and 1378).

Although the vaccines, as issued, are prepared from more than one strain of virus, it is obvious that from the results above mentioned any attempt in this direction to overcome " breakdowns " in immunity cannot be completely successful, even though the vaccinated horses may have been inoculated with several virulent viruses as immunity tests, subsequent to vaccination and prior to exposure.

The Inactivation of Vaccine.

The observations made and recorded in last year's Report should be referred to in conjunction with those indicated below.

There is no definite evidence as yet that toluol, by its action on the virus, produces any attenuation in virulence. Susceptible horses, inoculated with spleen extract containing toluol to make a 3 per cent solution of the drug in the mixture, have invariably reacted and died, even though this treated virus has been stored for some months. On the other hand, it has been observed that, when reactions have occurred in vaccinated horses on immunity tests, these reactions have been less severe in those horses inoculated subcutaneously with toluol-treated spleen extract than in those inoculated with virulent blood in O.C.G. solution. Further observations in this direction require to be made. It would seem possible, that the toluol-treated spleen extract contained a mixture of virus and vaccine, if not an actual attenuation, and that, although this material produced fatal results on inoculation to untreated horses, it may have shown a marked difference in its action (as compared with that of virulent blood in O.C.G. solution) on inoculation to partially resistant horses. So far, the actions of toluol and formalin on the virus have been observed to some extent, but the actions of other drugs might be tried, with advantage.

It was considered that spleen-tissue extract, treated with formalin (1 part of commercial formalin to 500 parts of the spleen extract in saline), was inactivated within twelve days when stored at about 4° C.

When it became necessary to prepare the vaccine in bulk, it was found that such treatment did not render the vaccine inactive within the period mentioned, in that in several instances such materials produced reactions on inoculation to susceptible horses at the Laboratory. In some cases these reactions terminated fatally. The following are the details :—

(*Note.*—1/1,000 formalin means 1 part of formalin to 1,000 parts of the vaccine, 1/500 formalin means 1 part of formalin to 500 parts of the vaccine, and so on.)

(*a*) Spleen vaccine 1339, treated with 1/1,000 formalin, and stored in the ice-box for 25 days, produced a temperature reaction followed by recovery (*see* Horse 1342).

(*b*) Spleen vaccine 1340, treated with 1/500 formalin, and stored in the ice-box for : (1) 7 days, produced a temperature reaction followed by recovery (*see* Horse 1345) ; (2) 10 days, produced a reaction which terminated fatally (*see* Horse 1344) ; (3) 12 and 15 days, produced no reactions (*see* Horses 1346 and 1348).

(*c*) Spleen vaccine 1347/49, treated with 1/500 formalin, and stored in the ice-box for : (1) 11 days, produced a reaction terminating fatally (*see* Horse 1351) ; (2) 22 days, produced a mild temperature reaction followed by recovery (*see* Horse 1364) ; (3) 29 days, produced a mild temperature reaction with recovery (*see* Horse 1358) ; (4) 45 days, produced no reaction (*see* Horse 1371).

It was found necessary therefore to test vaccine on three different horses, at different dates, before issuing same for field inoculations, and later it was decided to treat vaccine with 1/300 formalin and 1/400 formalin before issue. The vaccine was thereby rendered inactive more quickly, and field inoculations proceeded a little more satisfactorily.

Whether the above reactions resulted from a " mixture " of vaccine and a small amount of living virulent virus, or from a genuine attenuation of the virus, is yet to be decided. It should be noted that the inoculations were made in fairly large doses.

Had horses been available for further experiment in this direction, the inoculation of small doses of such vaccine would probably have decided whether or not a genuine attenuation of virus had been produced.

Vaccine and Virus Mixture.

A single experiment, to observe the results obtained by inoculation of mixtures of vaccine and virus, was carried out,

but no conclusions could be drawn. The experiment is recorded for further reference. The horse (*see* No. 1372) was inoculated as follows :—

To spleen-tissue extract in saline was added an equal amount of hæmolized virulent blood, and to every 300 parts of the mixture was added one part of formalin (referred to as 1/300 formalin). This mixture was stored for 22 days in the ice-box, and, forty-eight hours prior to inoculation, to it was added 2 c.c. of virulent blood in O.C.G. for every 100 c.c. of mixture. The whole was then thoroughly shaken and replaced in the ice-box. 100 c.c. of the mixture was inoculated subcutaneously to Horse 1372. No visible reaction resulted. A similar mixture was made for the second inoculation sixteen days later, the vaccine material being then thirty-eight days old. In this instance the vaccine and virus were mixed together only five minutes before the inoculation of 100 c.c. of the mixture was made. Again no visible reaction resulted, and the horse also showed no reactions to any of the three subsequnt inoculation immunity tests, nor to exposure to natural infection at Ulu. In an experiment of this nature, sub-inoculations to susceptible equines are most important, to determine whether or not at any time a reaction of some sort has occurred. Unfortunately, horses were not available for such tests, nor for any repetition of the experiment, using vaccines containing lower concentrations of formalin and greater amounts of virus, and with varying periods of contact of the two. The experiment, as such, is recorded for future reference. The result obtained should be confirmed, and further research in this direction might prove of advantage.

Is Lymphatic Gland Extract of Value as a Vaccine?

Only one horse was available for this experiment, but as he was a young country-bred, and suceptible, the experiment proved of value (*see* Horse No. 1395). The material was prepared as in the case of spleen-tissue extract, but gland material proved difficult to handle, and with the pulpers at our disposal a very coarse-grained pulp was obtained; and, although the amounts of inoculated material are given as 50 c.c. for each inoculation, these must be considered to contain relatively small amounts of gland extract. It was anticipated at the commencement of the experiment that a further supply of gland extract from a horse other than that from which the original material was obtained would be available for the third and fourth inoculations. This proved impossible, and therefore all four inoculations were made with the original

gland extract (ex Horse 1378), prepared on 5-8-30, and inactivated by the addition of 1/300 formalin. The vaccine was prepared from a strain of virus obtained at Kikuyu, and the first immunity test made with the same strain of virus. This resulted in a mild temperature reaction. A subsequent immunity test with " O " virus gave negative results.

Although only one horse can be shown in this experiment, and although the first immunity test resulted in a mild temperature reaction with recovery, the result would appear to indicate that lymphatic gland is of value as an immunizing agent, and possibly a fairly potent one. Further experiments are necessary to confirm the observations made.

Experiments with Formalized Blood, Serum, etc.

A preliminary experiment proved that blood, collected from a reacting horse (No. 1351), defibrinated and washed in the usual way with normal saline, the complete process of washing and centrifuging being repeated fourteen times over a period of two days, when injected in a dose of 2 c.c. to a horse (*see* No. 1360), produced a typical acute horse-sickness reaction, the temperature rising forty-eight hours after the inoculation, and the horse dying of the disease three days later. Centrifuged serum obtained from the same horse (No. 1351) and at the same time as the blood cells, produced a similar result on inoculation to Horse 1361 (*see* tabulated sheets).

An initial experiment was then carried out to determine the value, if any, of the following as immunizing agents :—

(*a*) Serum. (*See* Horse 1363.)
(*b*) Plasma. (*See* Horse 1370.)
(*c*) Blood clot free from serum. (*See* Horse 1367.)
(*d*) Blood cells free from plasma. (*See* Horses Nos. 1368, 1369, 1375, 1382 and 1383.)

(*a*) *Serum.*—As will be seen from the records, Horse 1363, inoculated on four occasions with serum treated with formalin (1/400), reacted immediately after the fourth inoculation and died of horse-sickness. The serum for each inoculation was taken from the one flask. It must be assumed that the serum produced the infection, and that the material used for the first inoculation, i.e. when it had been stored for fourteen days after treatment with formalin, was infective, and did not produce a temperature reaction until the 22nd day after inoculation. It should be noted that this apparently delayed reaction proved fatal. This result should be compared with some subsequent experiments carried out with " blood " vaccine.

(*b*) *Plasma.*—Horse No. 1370, treated with formalized plasma (1/300), did not react apparently to the plasma inoculations, but died of horse-sickness when inoculated with virulent blood. In view, however, of the result obtained with Horse 1363, treated with formalized serum, it is possible that Horse 1370 died as a result of inoculation with formalized plasma, the immunity test being carried out too soon. [Hæmolized blood, treated with formalin (1/300), produced a fatal infection—*see* Horse No. 1386.]

(*c*) *Blood clot,* treated with hypertonic saline, and subsequently reduced to an isotonic solution by the addition of distilled water, was then treated with formalin (1/400). On inoculation to Horse No. 1367, no reactions were produced. A slightly irregular temperature was observed after the second immunity test. This may have been a slight horse-sickness temperature reaction. No horses were available for sub-inoculations tests, either at the time or subsequently.

(*d*) *Blood cells,* treated as in the case of blood clot, inoculated to Horse No. 1368, showed no reactions to vaccine inoculations, but did show an irregular temperature after the second immunity test. This also may have been a horse-sickness reaction. No horses were available for sub-inoculation tests.

A further series of horses (Nos. 1369, 1375, 1382 and 1383) were inoculated with a vaccine prepared from blood cells which had been hæmolized by the addition of 1 part of distilled water to every 2 parts of cells, then treated with formalin (1/300), and stored in the ice-chest. As will be seen from the details in the tabulated sheets :—

Horse No. 1369 showed no temperature reaction from vaccination or immunity tests by inoculation or exposure.

Horse No. 1375 showed no temperature reaction as a result of vaccination or inoculation immunity test, but was reported to have run a slight temperature some time after exposure to natural infection.

Horse No. 1382 reacted fairly severely after the second immunity test and recovered.

Horse No. 1383 received, as in the cases of Nos. 1375 and 1382, two inoculations of formalized hæmolized blood, and was tested on its immunity seven days after the first inoculation. This resulted in a mild temperature reaction with recovery.

Horses 1382 and 1383 were young threequarter-bred Arabs, and the results obtained proved them to be susceptible. Without treatment, " O " virus would certainly have proved

fatal on inoculation. It seemed indicated that vaccine prepared from blood cells was of definite value, and experiments were then conducted to determine whether or not a vaccine prepared from a mixture of spleen-tissue extract and blood cells was superior to spleen extract alone. This vaccine will be referred to as " spleen plus blood vaccine." (Subsequently, a further lot of experiments was carried out with vaccines prepared from blood cells, and these will be referred to later.)

Spleen plus blood vaccine, prepared by mixing equal parts of spleen-tissue extract as used for vaccine, with hæmolized blood cells, prepared as previously described. In most cases the formalin was added to each constituent before they were mixed. As will be seen from the records in the tabulated sheets, spleen plus blood vaccine gave good results with Horse 1373, a young country-bred. When used in conjunction with spleen vaccine (*see* Horses Nos. 1353, 1396, 1397, 1398, 1389, 1390 and 1356) it gave satisfactory results, except in the case of one horse (*see* No. 1356), which died of horse-sickness on the second immunity test. One can only speculate as to the reason for this fatality. It is possible that the vaccine produced a complete " block-out " to the particular virus used, or that the horse was peculiarly susceptible to a particular generation of the one strain of virus.

It should be noted also that horses treated firstly with spleen plus blood vaccine, and subsequently with a formalized hæmolized blood vaccine, referred to as 1380 (*see* Horses Nos. 1394, 1396, 1397, 1398, 1400, 1401, 1402, 1403, 1404 and 1405), and which blood vaccine produced fatal results (*see*, e.g., Horse No. 1406), showed no reaction either to the blood-vaccine-1380 inoculations, or to subsequent immunity tests, with the exception of Horse No. 1394, which showed an irregular temperature after the second blood vaccine inoculation; while Horse No. 1384, receiving only one spleen plus blood vaccine inoculation, failed to react to a subsequent inoculation of formalized hæmolized blood vaccine 1380, but reacted with mild temperature reaction with recovery to a subsequent immunity test with virulent blood. This would appear to indicate that a potent vaccine can " block-out " a reaction to inoculation with an attenuated or otherwise modified virus; otherwise it is very difficult to explain why Horse 1384 did not react to the blood vaccine 1380 inoculation, especially since this material was only three days old at the time of inoculation, and it was taken from the same flask of material as that used for all subsequent inoculations made on other horses (*see* records).

An opportunity was taken of carrying out an experiment in the Eldoret district, using a combination of spleen vaccine and spleen plus blood vaccine for the inoculations. Seventy-odd horses were kindly placed at our disposal by Mrs. Alan Thompson and Messrs. Ridley and Hoey, the owners accepting all risks of the experiment, and supplying the necessary horses for the production and testing of the vaccine. The experiment was particularly valuable in that a number of horses were so treated. The spleen plus blood vaccine used was comparatively fresh material. It had been suggested that apparently inactivated vaccine might occasionally infect one or more horses, if a sufficient number were inoculated with the one lot of vaccine. The above horses were very closely observed by the owners, and apart from an occasional abscess at the site of inoculation no untoward symptoms or temperatures were observed to follow any of the inoculations. The majority of the mares were heavy in foal at the time the inoculations were carried out. The inoculations produced no untoward effects in these mares, and they subsequently produced healthy foals.

The horses were divided into approximately two equal lots, those at Mr. Ridley's stables receiving four inoculations, the first two being of spleen vaccine, and the third and fourth inoculations being of spleen plus blood vaccine; while the remaining horses received only one inoculation of spleen vaccine, followed by two inoculations of spleen plus blood vaccine. The spleen vaccines used were spleens 1350/55 and 1347/49; and the spleen plus blood vaccines were spleens 1363/70 and hæmolized bloods 1363 and 1370. It should be noted that blood 1363 produced no reactions when mixed with spleen vaccine, either at the Laboratory or on inoculation to horses at Eldoret; but when used alone it produced a fatal reaction on inoculation to a horse at the Laboratory (*see* Horse No. 1386). This observation should be compared with those made on Horse No. 1372, which was inoculated with a mixture of spleen vaccine and virulent blood.

Further Blood Experiments.

The initial experiments made to determine the value of blood cells as vaccine, and already referred to (*see* Horses 1367, 1368, 1369, 1375, 1382, and 1383), indicated some measure of success, and were repeated (*see* Horses Nos. 1386, 1387, 1388, 1391, 1392, 1393, 1406, 1407, 1408, 1409, 1410 and 1411). It will be seen from the tabulated sheets that in this second experiment a number of these horses died of horse-sickness as a result of the original inoculation with

formalized hæmolized blood, while some reacted and recovered and one horse (No. 1393) showed no reaction to any blood vaccine inoculation or immunity test. In the same lot of horses were included Nos. 1389, 1390, and 1394, each of which received spleen plus blood vaccine, prior to formalized hæmolized blood vaccine 1380 (which produced fatal reactions), and in each case no reaction was observed, either following vaccination or subsequent immunity tests.

As these unfortunate *sequelæ* did not occur within a period which one had previously considered as an incubation period for horse-sickness following inoculation, i.e., say, up to twelve days after inoculation, a number of horses were so treated before the reactions and fatalities were observed, and the number of horses lost thereby was, very unfortunately, considerable.

It will be noted that, in the case of Horse No. 1386, blood vaccine 1363 only was inoculated, with fatal results; and in the case of Horse No. 1406, blood vaccine 1380 alone was inoculated, with similar results. In the other fatal cases, both 1363 and 1380 blood vaccines were inoculated. Only one flask of each vaccine was available, therefore all inoculations of one vaccine came from a single flask. It must be assumed that the first inoculation made was infective in each case. It should be noted also that the dates on which inoculations with fatal issues were made are identical with those on which spleen-plus-blood-vaccinated horses were inoculated with this infective blood vaccine. The temperatures were noted to become suddenly elevated following the second, third or even fourth inoculation, and, in one instance, the reaction commenced twenty days after the first inoculation (*see* Horse No. 1392 and compare dates of inoculations with Horse No. 1386). All fatal cases were those of acute horse-sickness. Those which showed a temperature reaction with recovery were rather mild temperature reactions. Only one horse (No. 1393), receiving blood vaccine as an original inoculation, did not show a reaction to this material.

It is unfortunate that some of the horses did not receive but one inoculation. It would have been possible then to observe whether or not the subsequent inoculations were in some way responsible for the severe reactions and mortality. Since some horses recovered, it would seem possible that there was some alteration in the virulence of the virus, or that there was a mixture of vaccine and virus, the vaccine being insufficiently potent to protect against a fatal issue. It can only be assumed that the infection resulted from the inoculation

of the formalized hæmolized blood, as in the case with formalized serum (*see* Horse No. 1365); and with the present state of our knowledge, and the data available, no definite explanation can be given to account for the reactions and mortality. The results obtained are recorded here for further reference, and as they are inconclusive, the writer is of the opinion that further research is necessary before blood cell vaccine can be discarded as of no value.

Controls.

The list of horses shown under immunity test inoculations, concluding the tabulated sheets, are given as controls of the various viruses. These horses include Nos. 1343, 1347, 1349, 1355, 1360, 1361, 1362, 1365, 1366, 1381, 1414, 1350, 1380 and 1378.

Lab. No. of equine on experiment	Type and origin of equine	Number of vaccine inoculations	Number of immunity tests at weekly intervals	Results	Remarks
1321	Country-bred 2-year old ex Molo.	3	9	No reactions	
1322	Country-bred 3-year old ex Molo.	4	8	ditto	
1323	Country-bred 3-year old ex Molo.	5	6	ditto	
1324	Country-bred aged mare ex Molo.	9	2	ditto	
1325	Country-bred yearling ex Molo.	4	7	ditto	
1326	Country-bred 4-year old ex Molo.	6	5	ditto	*See* text for result of sub-inoculation test.
1327	Country-bred yearling ex Molo.	4	7	ditto	
1328	Country-bred aged mare ex Molo.	8	3	ditto	
1329	Country-bred 3-year old ex Molo.	4	8	ditto	
1330	Imported Arab stallion ex Molo.	10	1	ditto	
1331	Country-bred aged mare ex Molo.	10	1	ditto	ditto.
1332	Country-bred foal three months old.	4	7	Reaction after 1st inoculation.	*See* text for comments.
1333	Somali gelding ex Gilgil	5	5	No reactions	
1334	Somali mare ex Gilgil	3	1	ditto	
1335	Country-bred 5 months old Arab–Somali ex Gilgil.	3	6	ditto	
1336	Somali mare ex Gilgil..	3	6	ditto	
1337	Country-bred 8 months old Arab–Somali ex Gilgil.	2	7	ditto	
1338	Foal 1 month old by thoroughbred out of Somali mare.	3	4	Temperature reaction to 1st inocul.	ditto.
1296	Somali mare ex Eldoret	4	18	Died of horse sickness as result of last inoculation.	ditto.
1297	Thoroughbred 2-year old ex Eldoret.	4	18	ditto	ditto.

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1342	Country-bred 2-year old Arab-Somali ex Ulu.	Spleen 1339	Formalin 1-1000	25	1–4–30	60 c.c.	Reacted and recovered	16–4–30	"O" virus intravenously 10 c.c. blood 1340 of 6-4-30.	No reaction	Note that spleen treated 1-1000 formalin transmitted an apparently attenuated infection after 25 days.
								2–5–30	"O" virus intravenously 10 c.c. blood 1343 of 26–3–30.	,,	
								15–5–30	"O" virus intravenously 10 c.c. blood 1339 of 4–3–30.	,,	
								22–5–30	Exposed to natural infection at Ulu	,,	
1344	Country-bred 6-year old ex Njoro.	Spleen 1340	Formalin 1-500	10	17–4–30	60 c.c.	Reacted and died.	..	....	..	Reaction commenced 25–4–30, horse died 27–4–30. Note that spleen treated 1-500 formalin for 10 days produced fatal infection.
1345	Aged Somali ex Makuyu.	Spleen 1340	Formalin 1-500	7	14–4–30	50 c.c.	Reacted and recovered	2–5–30	"O" virus intravenously 10 c.c. blood 1340 of 6–4–30.	No reaction	Temperature reaction only. Note that same spleen material, viz., 1340, did not transmit after 12 days. *See* H. 1346 below.
								15–5–30	"O" virus intravenously 10 c.c. blood 1339 of 4–3–30.	,,	
								29–5–30	"O" virus intravenously 10 c.c. blood 1343 of 26–3–30.	,,	
								16–6–30	"Suspected" virus ex Ulu 10 c.c. blood intravenously.	,,	
								27–6–30	"Kabete" virus subcutaneously 10 c.c. blood 1365 of 19–6–30.	,,	
								12–7–30	"Kikuyu" virus intravenously 10 c.c. blood of 8–7–30 at Kikuyu.	,,	
1346	Country-bred 2-year old Arab-Somali ex Nanyuki.	Spleen 1340	Formalin 1-500	12	19–4–30	50 c.c.	No reaction	21–5–30	"O" virus intravenously 10 c.c. blood 1287 of 29–10–29.	Reacted and recovered	Reaction commenced 28–5–30 and was prolonged. Spleens apparently not potent as vaccine.
		,, 1339	,, 1-1000	24 38	1–5–30 13–5 30	,, ,,	,, ,,				

				Days		*Subcutaneously*					
1348	Country-bred Arab-Somali.	Spleen 1340	Formalin 1-500	15	22–4–30	60 c.c.	No reaction	5–5–30 22–5–30 30–5–30	"O" virus intravenously 10 c.c. blood 1340 of 6–4–30. "O" virus intravenously 10 c.c. blood 1343 of 27–3–30. Exposed to natural infection at Ulu	Reacted and recovered No reaction Temp. reaction	Mild temperature reaction. Note that 1340 spleen 1-500 formalin did not transmit infection after 15 days Possibly a second horse-sickness reaction occurred at Ulu.
1351	Country-bred aged.	Spleen 1347/49	Formalin 1-500	11	24–5–30	60 c.c.	Reacted and died.	..	....	..	Reaction commenced 29–5–30. Horse died 31–5–30.
1358	Country-bred gelding ex Moiben.	Spleen 1347/49	Formalin 1-500	29	11–6–30	60 c.c.	Reacted and recovered	..	....	..	Reaction commenced 21–6–30 and lasted three days.
1364	Country-bred 3-year old Arab-Somali ex Nakuru	Spleen 1347/49	Formalin 1-500	22	4–6–30	40 c.c.	Reacted and recovered reaction com'd 15-6-30 and lasted 3 days.	25–6–30 12–7–30 18–7–30 25–7–30	"O" virus subcutaneously 10 c.c. blood 1347 of 8–5–30; 10 c.c. blood 1349 of 11–5–30. "Kabete" virus intravenously 10 c.c. blood 1365 of 26–6–30. "Kikuyu" virus intravenously 10 c.c. blood ex horse at Kikuyu. Exposed to natural infection at Ulu.	No reaction " " "	Compare reactions of horses 1351, 1364 and 1358, with regard to age of material, periods of incubation, and severity. There appears to be some genuine attenuation of the virus, or a "mixture" of virus and vaccine which produces a mild reaction with recovery.
1363	Country-bred Arab-Somali ex Nakuru.	Serum 1351 " " "	Formalin 1-400 " " "	14 24 31 36	13–6–30 23–6–30 30–6–30 5–7–30	100 c.c. " " "	No reaction " " Reacted almost immediately and died	..	....	..	The formalized serum for each inoculation was from the one flask. Compare this result with the use of formalized hæmolized blood.

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1370	Somali aged ex Nakuru.	Plasma 1351	Formalin 1-300	3	16–6–30	100 c.c.	No reaction	3–7–30	"Kabete" strain virus intravenously 10 c.c. blood 1365 of 26–6–30.	Reacted and died Reaction com'd 9-7-30 and horse died 13-7-30.	It is possible that this horse died as result of inoculation with plasma 1351. *See* above—Horse 1363.
		,,	,,	10	23–6–30	60 c.c.	,,				
		,,	,,	15	28–6–30	100 c.c	,,				
1367	Somali aged ex Nanyuki.	Blood-clot 1351	Formalin 1-400	11	11–6–30	100 c.c.	No reaction	28–6–30	"O" virus intravenously 10 c.c. blood 1351 of 30–5–30.	No reaction	The irregular temperature recorded was a suspicious reaction. No horses were available for sub-inoculation.
		,,	,,	23	23–6–30	,,	,,	8–7–30	"O" virus intravenously 10 c.c. blood 1340 of 5–4–30.	Irregular temp. for some days.	
								25–7–30	"Kabete" strain virus intravenously 10 c.c. blood 1365 of 19–6–30.	No reaction	
								12–8–30	"O" virus intravenously 5 c.c. blood 1386 of 10–8–30.	,,	
								27–8–30	"O" virus intravenously 10 c.c. blood 1388 of 27–8–30.	,,	
1368	Somali stallion aged ex Naivasha	Blood cells 1351	Formalin 1-400	10	9–6–30	100 c.c.	No reaction	1–7–30	"O" virus intravenously 10 c.c. blood 1351 of 30–5–30.	No reaction	The irregular temparature recorded, was a suspicious reaction. No horses were available for sub-inoculation.
		,,	,,	24	23–6–30	,,	,,	14–7–30	"O" virus intravenously 10 c.c. blood 1340 of 5–4–30.	Irregular temp. for some days.	
		,,	,,	31	30–6–30	,,	,,	25–7–30	"Kabete" strain virus intravenously 5 c.c. blood 1365 of 19–6–30.	No reaction	
								12–8–30	"Kikuyu" strain virus intravenously 10 c.c. blood 1378 of 3–8–30.	,,	
								27–8–30	"O" virus intravenously 5 c.c. blood 1392 of 23–8–30.	,,	

				Days		*Subcutaneously*					
1369	Somali ex Nakuru.	Hæmolized blood 1365	Formalin 1-300	3	16–6–30	100 c.c.	No reaction	2–7–30	"Kabete" virus intravenously 10 c.c. blood 1365 of 12–6–30.	No reaction	No temperature recorded on exposure to natural infection.
		"	"	10	23–6–30	50 c.c.	"	18–7–30	"O" virus intravenously 5 c.c. blood 1360 of 6–6–30.	"	
		"	"	15	28–6–30	100 c.c.	"	25–7–30	Exposed to natural infection at Ulu.	"	
1375	Country-bred 3-year old Arab-Somali ex Nakuru.	Hæmolized blood 1362	Formalin 1-300	8	6–7–30	100 c.c.	No reaction	15–7–30	"O" virus intravenously 10 c.c. blood 1362 of 27–6–30.	..	Reported to have shown an irregular temperature for a few days soon after arrival at Machakos.
		"	"	14	12–7–30	"	"	6–8–30	Exposed to natural infection at Ulu, and subsequently at Machakos.		
1382	Country-bred 2-year old Arab-Somali ex Molo.	Hæmolized blood 1362	Formalin 1-300	21	19–7–30	60 c.c.	No reaction	30–7–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	No reaction	Temperature reaction commenced 21–8–30 and remained elevated for six days.
		" 1363	"	12	22–7–30	"	"	19–8–30	"O" virus intravenously 10 c.c. blood 1340 of 6–4–30.	Reacted and recovered	
1383	Country-bred 2-year old Arab-Somali ex Molo.	Hæmolized blood 1362	Formalin 1-300	17	15–7–30	100 c.c.	No reaction	22–7–30	"O" virus intravenously 10 c.c. blood 1363 of 11–7–30; 10 c.c. blood 1340 of 5–4–30.	Slight temp. reaction commencing 3rd day after inoc.	No symptoms beyond temperature reaction. Note—Virus given 3 days after second inoculation.
		Hæmolized blood 1363	"	9	19–7–30	60 c.c.	"	27–8–30	"O" virus intravenously 5 c.c. blood 1388.		
1353	Somali country-bred 3-year old ex Elmenteita.	Spleen + blood 1360	Formalin 1-300	3	9–6–30	60 c.c.	No reaction	31–7–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	No reaction	No symptoms throughout.
		Spleen 1347/49	1-500	41	26–6–30	60 c.c.	"	12–8–30	"O" virus intravenously 5 c.c. blood 1381 of 9–8–30.	"	
		Spleen 1362	1-300	7	7–7–30	50 c.c.	"	27–8–30	"O" virus intravenously 5 c.c. blood 1392 of 23–8–30.	"	
		Spleen + blood 1363/70	"	2	17–7–30	100 c.c.	"				

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1354	Somali stallion aged ex Elmenteita.	Spleen 1344	Formalin 1-500	37	4–6–30	40 c.c.	No reaction	25–7–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	No reaction	No symptoms throughout.
		1351	1-400	2	16–6–30	,,	,,	12–8–30	"O" virus intravenously 5 c.c. blood 1381 of 9–8–30.	,,	
		1347/49	1-500	45	27–6–30	,,	,,	27–8–30	"O" virus intravenously 5 c.c. blood 1392 of 23–8–30.	,,	
		Kikuyu virus	1-300	34	12–7–30	100 c.c.	,,				
1359	Somali country-bred 3-year old ex Nakuru.	Spleen 1350/55	Formalin 1-300	11	9–6–30	60 c.c.	No reaction	31–7–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	No reaction	No symptoms throughout.
		1347/49	1-400	41	23–6–30	50 c.c.	,,	8–8–30	Exposed to natural infection at Ulu.	,,	
		1362	1-300	7	7–7–30	50 c.c.	,,				
		Kikuyu virus	1-300	39	17–7–30	60 c.c.	,,				
1373	Country-bred 3-year old ex Nakuru.	Spleen + blood 1360	Formalin 1-300	19	25–6–30	100 c.c.	No reaction	18–7–30	"O" virus intravenously 5 c.c. blood 1360 of 6–6–30.	No reaction	No symptoms throughout.
		,,	,,	31	7–7–30	,,	,,	6–8–30	Exposed to natural infection at Ulu.	,,	
		,,	,,	38	14–7–30	,,	,,				
1372	Somali aged ex Nakuru.	Spleen + blood 1360 + virus 1360 as a mixture prepared 48 hours before inoc.	Formalin 1-300 in O.C.G.	22 virulent	28–6–30	100 c.c.	No reaction	23–7–30	"O" virus intravenously 5 c.c. blood 1360 of 6–6–30.	No reaction	No visible reaction was seen at any time. Sub-inoculations could not be made as no horses were available, and the experiment could not be repeated for the same reason.
								12–8–30	"O" virus intravenously 5 c.c. blood 1381 of 9–8–30.	,,	
		Spleen + blood 1360 + virus 1360 as a mixture prepared 5 minutes before inoc.	,,	38 virulent	14–7–30	100 c.c.	,,	27–8–30	"O" virus intravenously 10 c.c. blood 1392 of 23–8–30.	,,	

				Days		*Subcutaneously*					
1396	Country-bred ex Nairobi.	Spleen + blood 1363/70	Formalin 1-300	20	4–8–30	60 c.c.	No reaction	1–9–30	"O" virus subcutaneously 40 c.c. spleen 1339, Toluol 3 per cent.	No reaction	
		"	"	23	7–8–30	"	"				
		"	"	28	12–8–30	"	"				
		Hæmolized blood 1380	1-500	15	18–8–30	50 c.c.	"	16–9–30	"O" virus intravenously 10 c.c. blood 1339 of 6–3–30.	"	NOTE.—Horses 1396, 1397 and 1398 were 3-year old country-breds from the same owner. Each received spleen plus blood vaccine *before* hæmolized blood vaccine 1380 which produced untoward results in other horses, q.v. These three horses were subsequently returned to their owner for exposure to natural infection.
		Spleen 1378	1-500	19	25–8–30	"	"				
1397	Country-bred ex Nairobi.	Spleen + blood 1363/70	Formalin 1-300	20	4–8–30	60 c.c.	No reaction	1–9–30	"O" virus intravenously 10 c.c. blood ex H.1380 of 6–8–30.	No reaction	
		"	"	23	7–8–30	"	"				
		"	"	28	12–8–30	"	"				
		Hæmolized blood 1380	1-500	15	18–8–30	50 c.c.	"	12–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	"	
		Spleen 1378	"	19	25–8–30	"	"				
1398	Country-bred ex Nairobi.	Spleen + blood 1363/70	Formalin 1-300	20	4–8–30	60 c.c.	No reaction	5–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	No reaction	
		"	"	23	7–8–30	"	"				
		"	"	28	12–8–30	"	"				
		Hæmolized blood 1380	1-500	15	18–3–30	50 c.c.	"	16–9–30	"O" virus intravenously 10 c.c. blood 1340 of 6–4–30.	"	
		Spleen 1378	"	19	25–8–30	"	"				
1395	Country-bred gelding ex Naro Moru.	Gland 1378	Formalin 1-300	7	12–8–30	50 c.c.	No reaction	1–9–30	"Kikuyu" virus intravenously 5 c.c. blood 1378 of 6–8–30.	Reacted and recovered	Reaction commenced 4–9–30 and lasted 3 days, and was very mild.
		"	"	11	16–8–30						
		"	"	20	25–8–30	"	"				
		"	"	24	29–8–30	"	"	12–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	No reaction	
						"	"				
1400	Somali ex Ngobit.	Spleen + blood 1363/70	Formalin 1-300	28	12–8–30	50 c.c.	No reaction	9–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	
		Hæmolized blood 1380	1-500	15	18–8–30	"	"				
		Spleen 1378	"	27	2–9–30	"	"				

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1401	Somali ex Ngobit.	Spleen + blood 1363/70	1-300	28	12–8–30	50 c.c.	No reaction	9–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	Note.–Horses numbers 1400 to 1406 were from the one owner. They each received initial inoculation of spleen plus blood vaccine. Note the results of immunity tests. In addition, they each received an inoculation of spleen plus blood vaccine prior to their arrival at the laboratory.
		Hæmolized blood 1380	1-500	15	18–8–30	,,	,,				
		Spleen 1378	1-500	27	2–9–30	,,	,,				
1402	Somali ex Ngobit.	Spleen + blood 1363/70	1-300	28	12–8–30	50 c.c.	No reaction	12–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	No reaction	
		Hæmolized blood 1380	1-500	15	18–8–30	,,	,,				
		Spleen 1381/86	,,	27	4–9–30	,,	,,				
1403	Somali ex Ngobit.	Spleen + blood 1363/70	1-300	28	12–8–30	50 c.c.	No reaction	2–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	
		Hæmolized blood 1378	1-700	10	16–8–30	,,	,,				
1404	Somali ex Ngobit.	Hæmolized blood 1380	1-500	9	12–8–30	50 c.c.	No reaction	2–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	
		,,	,,	8	18–8–30	,,	,,				
1405	Somali ex Ngobit.	Spleen + blood 1363/70	1-300	28	12–8–30	50 c.c.	No reaction	12–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	No reaction	
		Hæmolized blood 1380	1-500	15	18–8–30	,,	,,				
		Spleen 1381/86	,,	27	4–9–30	,,	,,				
1384	Country-bred yearling ex Molo.	Spleen + blood 1363/70	Formalin 1-300	9	24–7–30	30 c.c.	No reaction	5–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	Reacted and recovered	Reaction commenced 9–9–30 and lasted 6 days.
		Hæmolized blood 1380	1-500	3	6–8–30	60 c.c.	,,				
		,, 1381	,,	15	25–8–30	30 c..c	,,				

				Days	*Subcutaneously*						
1371	Country-bred 3-year old ex Moiben.	Spleen 1347/49	Formalin 1-500	45	25–6–30	60 c.c.	No reaction	21–7–30	"O" virus intravenously 5 c.c. blood 1362 of 6–6–30.	No reaction	Result corresponds with that of H. 1384.
		Hæmolized blood 1362	1-300	12	12–7–30	,,	,,	5–8–30	Exposed to natural infection at Machakos.	Rep'ted temp. reaction	
		,, 1363	1-300	8	18–7–30	,,	,,				
1357	Country-bred 3-year old ex Moiben.	Spleen 1350/55	Formalin 1-300	27	25–6–30	100 c.c.	No reaction	29–8–30	"O" virus subcutaneously 50 c.c. spleen H. 1339, Toluol 3 per cent.	No reaction	The repeated inoculation with hæmolized blood appear to have produced immunity.
		,,	,,	36	3–7–30	,,	,,				
		Hæmolized blood 1365	,,	29	12–7–30	50 c.c.	,,	10–9–30	"O" virus intravenously 10 c.c. blood 1339 of 26–3–30.	,,	
		,, 1362	,,	18	18–7–30	,,	,,				
		,, 1363	,,	13	23–7–30	,,	,,				
		,, 1380	1-500	9	12–8–30	,,	,,				
		,, 1381	1-700	8	18–8–30	,,	,,				
1356	Country-bred 3-year old ex Moiben.	Spleen 1350/55	Formalin 1-300	21	19–6–30	60 c.c.	No reaction	21–7–30	"O" virus intravenously 10 c.c. blood 1362 of 6–6–30.		
		Spleen + blood 1360	,,	27	3–7–30	,,	,,				
		Hæmolized blood 1362	,,	14	12–7–30	,,	,,	27–8–30	"O" virus intravenously 5 c.c. blood 1288.	Reacted and died.	*See* text for comments.
		,, 1363	,,	8	18–7–30	50 c.c.	,,				
1386	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	18	30–7–30	100 c.c.	No reaction	..	....	..	This proves that hæmolized blood 1363, 18 days old, 1-30 formalin, transmitted the infection.
		,,	,,	25	6–8–30	,,	Reacted and died.				
1387	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	25	6–8–30	60 c.c.	No reaction	..	....	..	Reaction commenced immediately after 3rd inoculation.
		,, 1380	1-500	15	18–8–30	50 c.c.	,,				
		Spleen 1378	,,	19	25–8–30	,,	Reacted and died				

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1388	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	25	6–8–30	60 c.c.	No reaction	..	....	..	Reaction commenced immediately after 3rd inoculation.
		„ 1380	1-500	15	18–8–30	„	„				
		Spleen 1378	„	19	25–8–30	50 c.c.	Reacted and died				
1389	Country-bred ex Naro Moru.	Spleen + blood 1363/70	Formalin 1-300	14	29–7–30	100 c.c.	No reaction	5–9–30	"O" virus subcutaneously 50 c.c. spleen 1340, Toluol 3 per cent.	No reaction	Vaccine used was a mixture of spleen and blood. Horse was a heavy-weight country-bred.
		„	„	22	6–8–30	„	„	16–9–30	"O" virus intravenously 10 c.c. blood 1340.	„	
		„	„	28	12–8–30	„	„				
		„	„	34	18–8–30	„	„				
		Spleen 1378	„	23	29–8–30	50 c.c.	„				
1390	Country-bred ex Naro Moru.	Spleen + blood 1363/70	Formalin 1-300	14	29–7–30	60 c.c.	No reaction	29–8–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	Note inoculations and result almost identical with H. 1389.
		„	„	22	6–8–30	„	„	16–9–30	"O" virus intravenously 10 c.c. blood 1339 of 6–3–30.	„	
		„	„	28	12–8–30	„	„				
		„	„	34	18–8–30	„	„				
1391	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	18	30–7–30	40 c.c.	No reaction				Reaction commenced immediately after last inoculation.
		„	„	25	6–8–30	„	„				
		„ 1380	1-500	9	12–8–30	„	„				
		„	„	15	18–8–30	„	Reacted and died				
1392	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	18	30–7–30	30 c.c.	No reaction				Reaction commenced immediately after the last inoculation.
		„	„	25	6–8–30	„	„				
		Haemolized blood 1380	Formalin 1-500	9	12–8–30	„	„				Compare this series of inoculations with those of 1386
		„	„	15	18–8–30	„	Reacted and died				

1393	Country-bred ex Naro Moru.	Hæmolized blood 1363	Formalin 1-300	18	30–7–30	60 c.c.	No reaction	..	....	..	Compare this result with horses 1386, 1391 and 1392. It was possibly an immune horse prior to treatment. 'Spleen' vaccine was given as a precautionary measure.
		,,	,,	25	6–8–30	,,	,,				
		,, 1380	1-500	12	15–8–30	50 c.c.	,,				
		Spleen 1378	,,	19	25–8–30	,,	,,	16–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	No reaction	
		1381/86	,,	27	4–9–30	,,	,,				
		,,	,,	33	10–9–30	,,	,,				
1394	Country-bred ex Naro Moru.	Spleen + blood 1363/70	Formalin 1-300	14	29–7–30	40 c.c.	No reaction	..	....	..	Horse showed slight rise in temperature after inoculation of 18-8-30. This may have been reaction to hæmolized blood inoculation. Unable to make sub-inoculation to confirm
		,,	,,	22	6–8–30	,,	,,				
		Hæmolized blood 1380	1-500	9	12–8–30	,,	,,	18–9–30	"O" virus subcutaneously 40 c.c. spleen 1340, Toluol 3 per cent.	No reaction	
		,,	,,	15	18–8–30	,,	Slight reaction				
		Spleen 1378	,,	23	29–8–30	50 c.c.	No reaction				
1406	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	15	18–8–30	50 c.c.	Reacted and died	..	....	..	Compare with previous horses.
		,,	,,	22	25–8–30	,,					
1407	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	15	18–8–30	50 c.c.	Reacted and recovered	..	....	..	Reaction commenced 30–8–30, i.e., 12 days after 1st inoculation with hæmolized blood.
		Spleen 1378	,,	19	25–8–30	,,					
		H.S. serum 4873	..	..	30–8–30	As precautionary measure in view of previous results.					
		H.S. serum 4832	..	..	31–8–30						
1408	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	10	13–8–30	30 c.c.	Reacted and died	..	....	..	Reacted after second inoculation.
		,, 1381	,,	15	25–8–30						
1409	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	13	16–8–30	50 c.c.	Reacted and died	..	....	..	Reacted after second inoculation.
		Spleen 1378	,,	19	25–8–30	,,					

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
				Days		*Subcutaneously*					
1410	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	15	18–8–30	50 c.c.	Reacted and recovered	..	..	..	Horse-sickness serum given in view of previous deaths. Doubtful if of value in bringing about recovery.
		Spleen 1378	,,	19	25–8–30	,,					
		H.S. serum 4832	..	..	31–8–30						
		H.S. serum 4043	..	..	1–9–30						
1411	Country-bred ex Naro Moru.	Hæmolized blood 1380	Formalin 1-500	15	18–8–30	50 c.c.	Reacted and died				
		Spleen 1378	,,	19	25–8–30	,,					
		H.S. serum 4832	..	..	30–8–30						
		H.S. serum 4043	..	..	31–8–30						
1343	Somali mare. Aged.	..	..	..	..	..	..	21–3–30	"O" virus intravenously 5 c.c. blood 1283 of 26–8–30.	Died of of horse sickness.	*Control* of virus 1283. Reaction commenced 25–3–30. Horse died 27–3–30.
1347	? Country-bred Somali.	..	..	..	..	..	..	22–4–30	? Molo virus intravenously 10 c.c. blood 1335 of 12–1–30.	No reaction	Blood apparently not virulent.
								5–5–30	"O" virus intravenously 10 c.c. blood 1340 of 6–4–30.	Reacted and died	Control on virus 1340.
1349	? Country-bred	..	..	..	..	..	..	24–4–30	? Virus intravenously 10 c.c. blood 1345 of 22–5–30.	Reacted and died.	Reaction commenced 9–5–30. Horse died 12–5–30.
								8–5–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.		Control on virus 1343.

1355	Somali. Aged.	..	..	..	..	..	..	21–5–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	Reacted and died.	Reaction commenced 24–5–30. Horse died 26–5–30. Control on virus 1343.
1360	Somali. Aged.	..	..	..	..	..	..	31–7–30	Washed blood cells ex 1351 of 30–5–30. (2 c.c. intravenously), (2 c.c. subcutaneously).	Reacted and died.	*See* text *re* experiment on washed cells. *Control* on virus 1351.
1361	Somali. Aged.	..	..	..	..	..	..	31–7–30	Serum (centrifuged) ex 1351 of 30–5–30, 5 ?.c. subcutaneously.	Reacted and died	*See* text. Control on virus 1351.
1362	Somali. Aged.	..	..	..	..	..	..	30–6–30 23–7–30	Suspected "Ulu" virus 5 c.c. blood ex horse with temperature at Ulu. Drawn 29–6–30. "O" virus intravenously 10 c.c. blood 1282 of 1–11–29.	No reaction Reacted and died.	*See* text. Reaction commenced 26–7–30. Horse died 28–7–30. Control on virus 1282.
1365	Somali. Aged.	..	..	..	..	..	..	7–6–30	"Kabete" virus subcutaneously 5 c.c. spleen emulsion in saline ex horse died at Lower Kabete 6–6–30.	Reacted and died.	Reaction commenced 9–6–30. Horse died 26–6–30. *Control* on "+Kabete" virus.
1366	Somali. Aged.	..	..	..	..	..	..	4–6–30	"Molo" virus intravenously 10 c.c. blood 1297.	Reacted and recovered.	Reaction commenced 8–6–30, and continued until 25–6–20. *Control* on "Molo" virus.

Lab. No. of equine on experiment	Type and origin of equine	Material inoculated	Treatment of material	Age of material at time of inoculation	Date of inoculation	Dose and method	Result	Immunity Test			Remarks
								Date	Material and method	Result	
1381	Somali.	..	..	*Days* ..	..	*Subcutaneously* ..	..	4–8–30	"O" virus intravenously 5 c.c. blood 1360 of 6–6–30.	Reacted and died.	Reaction commenced 7–8–30. Horse died 10–8–30. *Control* on 1360 virus.
1414	Somali.	..	..	..	..	..	..	8–9–30	"O" virus subcutaneously 50 c.c. spleen 1339, Toluol 3 per cent.	Reacted and died.	*Control* on 1339 virus in 3 per cent Toluol.
1350	Aged mare.	Spleen 1297	Formalin 1-450	13	8–5–30	60 c.c.	No reaction	22–5–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	Reacted and died.	Reaction commenced 24–5–30. Horse died 27–5–30. NOTE.—Vaccine spleen 1297 is "Molo" strain of virus. No immunity against "O" virus. *Control* on 1343 virus.
1380	Somali.	Spleen "Kikuyu" virus	Formalin 1-300	6	14–7–30	60 c.c.	No reaction	28–7–30	"O" virus intravenously 10 c.c. blood 1343 of 27–3–30.	Reacted and recovered.	Reaction commenced 31–7–30 and lasted four days.
1378	Country-bred 8-year old.	Spleen "Kikuyu" virus	Formalin 1-300	10	18–7–30	100 c.c.	No reaction	28–7–30	"Kikuyu" virus intravenously 5 c.c. blood of 8–7–30 from reacting horse at Kikuyu.	Reacted and died.	Control on "Kikuyu" virus.

ELEVENTH INTERNATIONAL VETERINARY CONGRESS, LONDON, AUGUST 4TH–9TH, 1930.

The Chief Veterinary Research Officer attended the Congress as delegate appointed by Government to represent Kenya on the research side, and took part in the discussions of diseases on the agenda which are of economic importance in Kenya, and on his return submitted a report.

Approximately 1,800 members were enrolled for the Eleventh Congress, a large proportion of them were delegates appointed by fifty foreign nations, and sixteen dominions, colonies or dependencies of the British Empire, and many were representatives of local authorities, veterinary colleges, research institutes, agricultural and other allied societies in Great Britain.

An opportunity was afforded of exchanging views and arranging for an exchange of material with reseach workers who are investigating diseases common to the old world and tropical countries, or peculiar to tropical and sub-tropical countries.

The papers submitted by delegates to the Congress and discussions hereon indicated the general trend of research in diseases of importance to the Colony and the direction in which results of practical utility are likely to be obtained.

PUBLICATIONS.

The research work carried out by officers of the Veterinary Research Laboratory during the year is recorded in the Annual Report of the Chief Veterinary Research Officer which is embodied in the Annual Report of the Agricultural Department, Kenya Colony, for the corresponding year.

The following were also published :—

" Memorandum on Rinderpest Research in Kenya Colony," by J. Walker, Chief Veterinary Research Officer, communicated to the Eleventh International Veterinary Congress.

" Aids to Stockowners," (Revised Edition), by J. Walker, Chief Veterinary Research Officer.

" Memorandum on Horse-Sickness Immunization," by S. H. Whitworth, Veterinary Research Officer. Communicated to the Eleventh International Veterinary Congress.

STAFF.

I wish to record my appreciation of the assistance given by the staff during the year.

J. WALKER, *Chief Veterinary Research Officer.*

APPENDIX IV.

ANNUAL REPORT
OF THE SENIOR ENTOMOLOGIST, 1930.

The distribution of the staff during the year has been practically the same as during 1929. The Senior Entomologist, the Insectaries Manager and the Clerical Staff are stationed at the Scott Agricultural Laboratories. Mr. Wilkinson is stationed at Nakuru, Dr. James (until he went on leave) in the Thika–Makuyu area, Dr. Le Pelley in the Kiambu–Limuru area, and before the end of the year Mr. Notley was posted to the Koru–Songhor area.

Summary of Work Done.

Travelling by staff : 23,466 miles.

Advisory correspondence : 1,701 letters.

Specimens examined and reported on : 679.

Permits for plant importation scrutinized : 188.

Plant exports examined : 85.

Publications : 2 (*see* general list).

Insect Pests.

As was the case last year, with the exception of correspondence and routine work, practically the whole time of the entire staff of the section has been devoted to the investigation and control of insects damaging the two major crops of the Colony, namely coffee and maize. Mr. Wilkinson, at Nakuru, has worked almost entirely on pests affecting the maize industry. Dr. James, for the part of the year he was in the Colony, and Dr. Le Pelley, for the whole of the year, have devoted their time to pests on coffee. The reports of these officers, which are here given in their entirety, will be read with interest by those concerned.

Coffee.

Deudoryx lorisona, Hew., the coffee berry butterfly. Although samples of the damage have been received from various districts, this insect is still a minor pest of coffee.

Thliptoceras octoguttale, Feld., the coffee berry moth. From samples forwarded by inspectors and damaged beans received from the Nairobi Coffee Curing Company, this pest shows a much wider distribution and must be responsible for a considerable loss in the aggregate.

Sophronica ventralis, Auriv., has not been so much in evidence, although several samples of *buni* have shown a very heavy infestation.

Stephanoderes hampei, Ferr., the coffee bean borer. The results of last year's campaign are very evident. Inspection has still been carried on and from the great majority—practically all—of the plantations on which the borer was found last year, there are no records for 1930. From the 497 samples submitted to me, eight only have shown *Stephanoderes* damage. The distribution of these is : Thika 1, Kiambu 1, Turbo 1, Sotik 1, Kaimosi 4. That from Turbo is a new record of distribution. All samples from Kaimosi showed a very heavy infestation.

Stem Borers.—*Apate monacha*, F., the black borer, *Anthores leuconotus*, Pasc., the white coffee borer, *Dirphya princeps*, Jordan, the yellow-headed borer, have all been reported but none of these seems to be on the increase and the control measures advocated have been found effective. There have been no further reports of *Bixadus sierricola*, White, and *Phlœobius pustulosus*, Gerst.

Leaf-eating Caterpillars.—The caterpillars of *Metadrepana andersoni*, Tams, have been responsible for considerable defoliation in the Sotik, Kericho, Koru, Songhor, Muhoroni and Trans Nzoia districts. The control has been dusting or spraying with arsenate of lead.

Scale insects other than mealy-bug.—These, as before, have been recorded from every district where coffee is grown, but from actual observation and from reports received, the control measures advocated, if properly carried out, have been successful.

Mealy-bug.—At the beginning of the year ten plantations were selected for monthly observation. Dr. Le Pelley did the inspection work and wrote monthly notes on each plantation. A number of facts of practical importance are evident from these notes, many of which are generally recognized, but for which it is interesting to have the evidence here collected on a number of estates at periodic intervals. Some of them may be summarized here.

(1) There is good hope of preventing attacks of mealy-bug attended by *Pheidole punctulata* from becoming of great severity, by constant attention to bands, prevention of contacts, painting the colonies, and other control measures.

(2) A heavy attack may persist despite continued efforts at control.

(3) An attack attended by *Acantholepis capensis* alone may become so severe as to necessitate banding.

(4) The attack need not necessarily be severe even though *Pheidole punctulata* and *Acantholepis capensis* are both present.

(5) Banding may induce the rapid improvement of a bad attack.

(6) Even in one district it is not possible to make an unqualified generalization about any feature of the mealy-bug infestation. Conditions vary so widely that every planter should endeavour to acquaint himself with the factors influencing the mealy-bug on his estate.

(It is not possible to publish Dr. Le Pelley's full notes in this report, but anyone desirous of further information on the observations taken should correspond with the Senior Entomologist.)

Dr. Le Pelley reports on his work in the Kiambu District as follows :—

Work has chiefly been confined to the common mealy-bug of coffee.

In addition it has been possible to devote some time to observation on and work with *Lygus simonyi*, Antestia, and the Lepidoptera which bore in coffee berries.

None of these investigations was brought to a conclusion during the year, but considerable progress was made and important facts ascertained. At the end of the year a technical paper on Antestia was in the course of preparation, to be followed by one on Lygus. Most of the work on Antestia during the year will be incorporated in a Departmental Bulletin to be published later.

Mealy-bug.—Observations and experiments begun in 1929 have continued.

Further observations on the various species of ants attending mealy-bug in the Kiambu District have shown that in this district (with the single exception of one estate at one particular time) a very severe attack only develops with the attention of the ant *Pheidole punctulata*. In at least one considerable area of that district containing many important coffee estates, *P. punctulata* is not now present, and it is of

interest to record that the mealy-bug present in this area has nowhere been so serious as is common in neighbouring estates which harbour the ant. *Acantholepis capensis* has been the only ant present with some attacks of moderate seriousness, and this species and Pheidole are sometimes present together. None other of the several species of ants which attend mealy-bug has ever alone been found with a serious attack. On the question of whether to band it may generally be said that if *P. punctulata* is present it is always necessary, if Acantholepis is present it may be necessary, and if any other species is present, alone, it is unnecessary. It is advisable for every planter to ascertain what species of ant is present on his estate. In Kiambu one case of a bad attack of mealy-bug developing and remaining for some time without any attention from ants has been observed, and there have been some further cases in other districts to show that in favourable conditions the bug can increase to such an extent as to cause a severe outbreak without ant attention. In any such case it seems important to stress the opinion of Dr. James, given in the Annual Report for 1929, that the advice of an entomologist should be obtained before control measures are decided on.

A number of field and laboratory trials of various sprays for use against mealy-bug have been made. The sprays used were a number of proprietary preparations, and also sprays prepared by the Agricultural Chemist using plant extracts as the toxic principles. This work in collaboration with the Agricultural Chemist is to be continued, with the use of an experimental sprayer designed by him to determine with accuracy the relative toxicities of contact insecticides, which should give results of value.

It has been shown that these " plant-poison " sprays are toxic at low concentrations and in this respect seem to compare most favourably with the proprietary sprays tried. It is now certain that spraying is ineffective in preventing an epidemic attack of mealy-bug once this has begun to develop; but evidence still goes to show that in certain cases it may be of valuable assistance in conjunction with other control measures. Work is still to proceed on this subject.

No detailed study of the predators of mealy-bug has been undertaken, but the capsid bug discovered in Kiambu in 1929, since identified as *Deraeocoris fulleborni*. Popp., was noticed again in the district during the year. Owing probably to the less intensive infestations of mealy-bug in the district during

the year, its numbers were considerably less. It was, however, present in exceptionally large numbers in Makuyu at the end of the year, where it would seem undoubtedly to have been one of the major predators.

Very useful measures for the control of mealy-bug are known and they have now been applied for several years with good, though not quite invariable success. While much work still remains to be done to improve the methods of banding, to assist the predators, and actually to destroy the mealy-bug on the trees, it is the writer's opinion that the only hopeful artificial attempts to reduce the mealy-bug from its position as a first-class pest in this country are through "long-range" researches, such as the connexion between soil conditions and the incidence of mealy-bug on which the Senior Coffee Officer is carrying out investigations; and the attempt to obtain or breed a good coffee resistant to the insect.

Lygus simonyi.—Early in the year it was noticed in parts of Kiambu that the blossoms in the spike stage were turning black and failing to set. Although blossoms had previously been known to abort in this manner, the condition in this district in March was considerably more serious than it had been known to be at any previous time. The most usual opinion was that the abortion was due to some climatic condition, possibly excessive rainfall, but at the same time a capsid bug was present in large numbers on the trees and from preliminary observations that the number of insects present and the amount of failure of the blossoming were nearly always in direct proportion, the writer thought it advisable to initiate a series of infection experiments to determine whether or not the bug could cause this flower-bud abortion. A paper giving the results of these experiments will be published later; here it may suffice to say that the feeding of the bug on the young flower spike was shown to be able to cause the typical form of flower-bud abortion noticed in the field. At least one other cause (unexplained) of the non-setting of flowers was also noticed, but the bug may be considered as the most important factor in this serious condition. There is evidence that the bug was enabled to do serious damage this year because the coffee produced many small flowerings rather than a main March flowering as is more usual in this district. The bug is widely

spread in the coffee districts of the country and did appreciable damage in several of them, notably in Kiambu and Nyeri, where the damage was very serious on some estates.

It is still to be seen whether the bug will remain continually to do damage, or whether this year's attack occurred because of some peculiar conditions particularly favourable to it. It seems likely that the bug will be one of the country's permanent coffee pests, though it may seldom be so serious as this year.

For several reasons this bug is particularly difficult to control, and it must here be stated that none of the methods tried have proved satisfactory. In England the control of the apple capsids is by contact spraying. This has not yet been tried because in this district contact spraying of whole estates is not usual. If planters were prepared to use a contact spray against this bug, it would doubtless be possible to obtain a considerable measure of relief.

Antestia.—This well-known pentatomid is a serious pest of coffee in Kiambu. The poison-bait-spray method of control is well known and widely practised. Many plants find it a very satisfactory control of the insect, while others are dissatisfied with it.

Early in the year the writer had in mind as an important subject for investigation, this varying of results following application of the bait and some work has been done on this point when the opportunity occurred. It is known that the eggs of antestia are parasitised by several minute hymenoptera. The percentage of eggs parasitised is usually high, being sometimes more than 90 per cent. Whether the lack of uniform success with this measure might at least in part be due to the poisoning of these parasites was investigated. While this was done a complete inventory of all the insects poisoned was made. In one case the insects poisoned on one tree was over 1,350; most of these were flies, but more than 100 were hymenopterous parasites, some of them known to be parasites of Antestia, of Thliptoceras and of some of the scale insects. In addition, laboratory tests showed that the Antestia egg parasites were strongly attracted to the poison bait and died after feeding on it for a very short time. A more detailed description of these experiments will be published later; it now appears likely (although opportunities for its complete mathematical proof have not occurred) that some of the failures with the bait are caused by the destruction by it of the

Antestia parasties. It is not desired to suggest that the spray should not be used, or even, here, that it is dangerous to use it, because the writer considers it a proved and valuable remedy, but the above observations may help in deciding when the spraying should be done, and when it would be wiser to rely on hand picking of the bugs and eggs and liberation of the parasites.

If the weather remains dry for several days after the application, most of the Antestia will be killed, and the fact that the parasites are also killed will not be of great importance; but if rain occurs soon after the spraying, the probability is that the egg parasites will be killed and the bug not, and hence it may increase. Further work is contemplated as opportunity offers, and it is expected that more detailed recommendations will be made in a Departmental Bulletin.

The Lepidoptera Boring in Coffee Berries.

During the year the incidence of Thliptoceras and Deudoryx was above normal. In one case an attack of these two insects combined caused a loss of more than a quarter of the crop in one block of coffee. Elsewhere during the year Thliptoceras has been a definite pest rather than the "beneficial crop-thinning agent" that it has sometimes previously been claimed. A preliminary study of the berry-boring lepidoptera has revealed several new species which bore in the berries, and a large number of parasites of these various lepidoptera have been discovered. A large number of these have been bred from Thliptoceras and Deudoryx, and they must be in large part responsible for the natural control of these insects. In addition, however, it has also been discovered that some of these parasites are themselves parasitised, and these hyper-parasites in some measure reduce their efficacy.

Planters, up to the present, when the attack of these berry borers has seemed sufficiently serious, have collected the bored berries and destroyed them. It may now be advised that they keep the berries, allow the parasites to escape, and kill the moth or butterflies that emerge. Later it may be possible to devise a means of separating the moths, the parasites and the hyper-parasites.

The Insectaries Manager reports as follows:—

The work in the Insectaries was confined chiefly to the rearing of the imported ladybird, *Cryptolæmus montrouzieri*, Muls.

Owing to the demand for these predators, they were distributed immediately on hatching so that very little experimental work could be carried out. However, under laboratory conditions it is safe to conclude that the beetle breeds throughout the year, and is unlike the indigenous species in this respect. A comparison as to the rate of increase between these two species was made and from the following figures it will be seen that the result was very much in favour of *Cryptolæmus*.

400 *Chilocorus angolensis* in ten weeks produced 2,800.

400 *Cryptolæmus montrouzieri* in ten weeks produced 17,000.

The above comparison is arrived at purely under laboratory conditions, and as field knowledge of *Cryptolæmus* is practically nil, it is impossible to make any statement as to the relative merits of these species in the field.

It is necessary here to recall the fact that in August, 1929, only eight live adult *Cryptolæmus* were received from South Africa. From the progeny of these, distribution was commenced on the 27th January, 1930, and continued until September, 1930. Owing to the scarcity of food (mealy-bug) it was found necessary to retain only one hundred adults until a further supply of food was available. This meant no field liberations could be made during October and November. However, from the progeny of the one hundred retained, liberations were again commenced in December, the total liberations during the year amounting to 100,000.

An average of 1,700 potato sprouting trays, necessitating eleven tons of potatoes, were used throughout the year for the propagation of the host plant for mealy-bug.

The chief difficulty, and in fact the only difficulty experienced, has been an insufficient quantity of mealy-bug for infecting the host plant, and as it is impossible, with the limited number of sprouting trays at my disposal, to keep a supply of infected sprouts for re-infection, collections of infected material from coffee plantations have had to be made. Infected coffee, unless at the pruning season, does not readily lend itself to collection in any vast quantity and this naturally limits the output of *Cryptolæmus* to a great extent.

Maize.

Mr. Wilkinson reports as follows :—While stationed in Nakuru my duties were to conduct investigations on insect pests of cereal crops.

The chief of these is maize stalk borer, *Busseola fusca*, Fuller.

Little fundamental research work on this pest has been done in Kenya and while a scientific officer must spend most of his time inspecting maize crops and carrying out the Rules under the Diseases Ordinance, it will be impossible to get this fundamental research done.

The administrative area of Nakuru and Ravine is so large that it warrants an inspector being stationed here permanently, thus leaving a scientific officer free to undertake research into the many problems which need solution. It is recommended that such an inspector be appointed.

Maize Stalk Borer.—The more observations that are made on this pest the more evident it becomes that a restricted period for planting maize must be insisted upon if the pest is to be controlled within economic limits.

From October, 1929, to July, 1930, inclusive, after which planting was prohibited by regulation, maize was planted during each month with the result that stalk borer was provided with sufficient suitable food material for its continuous existence and the pest was carried over from one season's crop to another. Crops planted between October, 1929, and February, 1930, were few, and in these stalk borer concentrated. Concentration took place to such an extent that over 70 per cent of the stalks became infected. Not only was the percentage of stalks infected high but each stalk contained an average of six larvæ or pupæ; as many as twenty were found in a single stalk. Though heavy rains and consequent bad roads made travelling difficult, the whereabouts of these crops was ascertained and, by the end of March, they were all destroyed under the Diseases of Plants Prevention Ordinance Rules. I venture to suggest if such infested crops had not been observed and so timely observed, the whole of the 1930 maize crop in certain areas would have been jeopardized. As a result, these same areas this year have been relatively free of stalk borer with the exception of the late June and July plantings. The latter crops again acted as suitable laying grounds for the few moths hatching from the earlier planted crops of March and April. During the period under review, difficulty has been experienced in getting volunteer maize destroyed. There were two chief reasons for this :—

1. Due to various causes, much land, previously under maize, went out of cultivation.

2. Rain was so generous that for a time it became almost impossible to plough certain lands. Consequently volunteer maize had to be destroyed by hand labour instead of by the quicker and more economical method of ploughing in these young plants.

Volunteer maize constitutes a serious menace and this is shown by the following facts :—

1. Maize planted on the 1st March near to land which had gone out of cultivation and which was full of volunteer maize became infested to an extent of 57 per cent. Maize planted at the same time in the same district but not near to volunteer maize showed a 2 per cent infestation.

2. In another district where maize was planted adjacent to volunteer maize the infestation on the same farm varied between 14 per cent in juxtaposition to the volunteer maize and 1 per cent 1,000 yards away.

Evidence has been obtained showing the influence of time and position of planting maize upon the degree of infestation by stalk borer.

For example, in areas where most of the volunteer maize had been destroyed and where maize was planted during each month from the 1st March to the 15th July inclusive, the degree of infestation by stalk borer was progressively greater and varied between 2 per cent on the March–April plantings, 8 per cent in the late May, 26 per cent in June, and 72 per cent in the July plantings. In the latter case the late crop was completely surrounded by maize planted during March and April and infestation was general throughout the crop.

In another instance where a crop was planted during July there was early planted maize at one side only and the two crops were separated by a road and uncultivated land about 60 feet across. Proceeding at right angles to the road from the early planted crop, which had a 5 per cent infestation, into the late planted crop, the infestation was found to be 52 per cent for a distance of 120 rows of maize. Beyond this the percentage infestation became gradually less until at the top of the 132 acre field it was only 3 per cent.

It would thus appear that the moths hatching from older maize stalks seek and prefer younger maize upon which to lay their eggs and do not fly far if and when such young maize is available.

The above instances, typical of many, show conclusively that by planting maize over a period of several months conditions are being provided for the progressive multiplication and rapid increase of moths; by planting maize crops so late in one year that they are still unharvested when the early planted crops of the following year commence to appear, they act as so many reservoirs from which new infestations proceed.

The menace which these crops constitute to neighbours and to the maize industry generally cannot be over-emphasized. Not only are they a menace as a source of infestation by stalk borer, but they are a menace because they considerably reduce the average yield of maize per acre throughout the Colony, and it is the writer's opinion that they have contributed no small quota to the uneconomic position in which many farmers find themselves to-day.

It is felt this latter point will be more fully stressed by the Plant Breeder and by agricultural officers who are more directly concerned with yields per acre, but it is so important in the economics of maize farming and the control of stalk borer that emphasis must be placed upon it here.

The majority of farmers are fully aware that the best yields of maize are to be otained from crops planted from about February 20th to May 31st, according to elevation. To plant at other times is to gamble with the weather and the instability of the rains of this region. The later planted crops more often than not produce from two to seven bags per acre. It is maintained that these are not economic yields.

Control Measures.—The Department of Agriculture, South Africa, recommends maize growers to practise "top dressing" with Derrisol as a control for maize stalk borer. It also states: "Top dressing has been generally successful whenever it has been properly done and it seems reasonable to predict that within a few years it will be generally practised as an ordinary farm operation." (*Farming in South Africa*. Vol. V, No. 54).

Experiments have been conducted with Derrisol during the past season, using one part of Derrisol to 1,000 of water by measure and 1 : 600. The former strength is recommended in South Africa. During these experiments it was found necessary to use a strength of 1 : 600 before complete success was attained.

Maize growers suffering from this pest are strongly recommended to use Derrisol as a top dressing.

Maize stalk borer in Kenya provides a typical instance of a pest which can be controlled by better agricultural practice and one is of the opinion that not one cent need be spent in the control of this pest other than that spent indirectly on better farming methods.

1. As soon as possible after harvesting, destroy all maize stalks by burning or by turning into manure by the Adco process.

2. Destroy all volunteer maize.

3. Establish a close season for maize by planting at such times between February 15th and May 31st, according to elevation, as to allow a period of at least three weeks to elapse between the time of destruction of all maize stalks and the commencement of planting the following season's crop.

In regard to 3, maize is grown at elevations between 5,000 and 8,000 feet, so that the time taken for the crop to reach maturity necessarily varies. Broadly speaking, this is between six and nine months. At higher elevations, where a crop takes nine months to mature, planting of maize should not take place after April 30th each year. At these elevations the planting season will be shorter than at lower elevations. It may be said that two-and-a-half months is not sufficient time in which to plant up a considerable acreage of land. Anyone stating such is merely showing that insufficient tackle is being used over the acreage put under maize. This, of course, is the average position in Kenya.

Land not planted to maize by April 30th could be put under an approved variety of wheat, as an alternative crop, with a fair chance of obtaining good results.

At lower elevations the planting season could extend to the end of May and a close season still be maintained. Later than May 31st maize should not be planted owing to what has been said above relative to yield and percentage infestation by stalk borer.

Though the wisdom of legislation on this matter may be doubted, it is believed that only by legislation and the strict enforcement of the Rules drawn up will the planter be protected against himself and will stalk borer be controlled.

Individual representation made to Government to alter the Rules or dates of planting should not be countenanced.

Cutworms.—It is known that several species of cutworm frequently are present and do considerable damage by cutting off about ground level the young maize plants. During the present year these insects have been difficult to find. Two hundred hours have been spent at different times following the plough and searching in other ways for these insects, only to find that about sixty cutworms were collected.

Heavy rains have been general throughout the district.

In the present state of our knowledge, we do not know the effects of the various meteorological factors on the seasonal abundance and activity of these Noctuids.

Two cases of reported damage by cutworm were investigated. In one case 3 per cent of the young maize plants had been destroyed by cutworm whereas 58 per cent of the plants were missing as a result of bad planting; either wrong plates had been used or the planter was driven too fast during planting operations.

In the other case 0.2 per cent was due to cutworm attack and 24 per cent due to bad planting. In this case the cogs of the planting machine had been slipping.

To a greater or a smaller degree such bad planting was common throughout the district.

Top Grub of Maize.—This insect has not been at all common during any part of the season.

Wireworms.—About twenty acres of maize on land previously sown to oats was destroyed by *Elaterid larvæ* sp. (?).

Weevils.—Considerable damage to maize in store has been caused by the attacks of weevils—*Calandra oryzæ.*

During the year the position became sufficiently serious to warrant a special investigation being made. At the same time it was suggested that experiments be conducted on the fumigation of maize and maize cribs, using railway tarpaulins and carbon bisulphide.

During the above investigations in the Uasin Gishu and the Trans Nzoia districts it was found that the average maize crib was badly constructed, was generally too wide to allow of rapid drying of the maize and was often in a state of dilapidation.

Of some 75,500 bags of maize inspected on twenty-one estates, 19.2 per cent were found heavily infested by weevil and 86.7 per cent determined by the Government Grader as being wet.

In every case of heavy weevil infestation this could be traced to maize infested in the field and this maize being stored in the same crib as clean maize.

Thousands of weevils were examined, all of which proved to be *Calandra oryzæ*, L.

The optimum development of *C. oryzæ* appears to be attained at temperatures between 60 degrees F. and 68 degrees F., with a moisture content of maize between 14 per cent and 15 per cent. The temperature of maize in the crib between the hours of 8 a.m. and 4 p.m. was found to be 68 degrees F. in each case tested. The moisture content of the maize varied between 12 and 14 per cent, though most had a moisture content of between 13 and 14 per cent. Thus it was found that most favourable conditions were present for the development of weevils.

Three types of fumigation experiments were conducted :—

(*a*) By completely wrapping a maize crib in tarpaulins.

(*b*) By wrapping bags of maize in tarpaulins under cover of a shed.

(*c*) By wrapping bags of maize in tarpaulins in the open air, and using 11.5 lb. of carbon bisulphide per 1,000 cubic feet of space enclosed.

The thoroughness with which these experiments were conducted and the large quantities of carbon bisulphide used proved conclusively :—

1. The material of which the tarpaulins were made was not airtight.

2. Unless an airtight chamber be provided, fumigation is not practicable.

3. That fumigation of maize in cribs, as at present constructed, is not feasible.

It was estimated that over 400,000 bags of maize were awaiting delivery in the Trans Nzoia district alone. Of this quantity, over 346,000 bags were wet. The weather conditions over a period of a few months had been such that the

maize failed to dry while in the crib. Not only that, but dry maize was absorbing moisture from the atmosphere and becoming wet.

In order to save this wet maize and prevent it being destroyed by weevil, the erection of drying plants was recommended. Many home-made drying plants were found and inspected on farms. In all cases they were noticed to be liable to damage the maize by over-heating. Such home-made drying plants should be discouraged if the good name of the Colony's maize is to be safeguarded.

The following precautions to prevent reinfestation of the new crop were recommended.

Fresh grain should not be exposed to attack by storing near to infested grain or cribs known to contain weevils.

Before storing the new crop, maize cribs should be thoroughly cleaned; merely brushing out a crib is not sufficient because cracks and crevices are usually full of infested grain. All grain and rubbish, which serve as breeding places, should be removed and the crib given a liberal application of paraffin or some good disinfectant.

Storage places should be constructed so as to be easily kept clean and in such a manner as not to allow materials to collect and afford lurking places for weevils. Cribs should be raised off the ground and sufficient space allowed for a boy to be able to get underneath and thoroughly clean up. The ground underneath can be made unsuitable for the breeding of weevils by applying a two-inch layer of naphthaline and lime, or Vermikol and lime, containing 5 to 10 per cent naphthaline or Vermikol (para-di-chlorbenzine).

Owing to the seasons overlapping this year, it may be necessary to build new cribs. These should be built away from the old ones.

Frequent handling and agitation of the grain by winnowing, riddling on coffee trays, every four or five weeks, will rid most of the grain of weevils, but not eggs; hence, frequent handling, Where field infestation is found, this will be in those cobs with loose open sheaths. These cobs should not be stored with uninfested cobs. All cobs showing weevil infestation should be shelled early and winnowed to remove the weevils. A little instruction given to natives will soon teach them to separate the infested cobs while harvesting.

Edible canna.—Several reports have been received that stalk borer (*Busseola fusca*, F.) was living in the stems of this plant. On only one case were specimens of larvæ forwarded. These proved to be larvæ of the noctuid moth, *Phytometra chalcytes*, Esp.

Wheat.—In almost every field of wheat inspected during the past year a few plants were collected, the stems of which contained lepidopterous larvæ. All efforts to bring these larvæ to maturity have failed and adults have not been procured. The same insect was found boring in the stems of oats.

THOS. J. ANDERSON,
Senior Entomologist.

APPENDIX V.

ANNUAL REPORT OF THE SENIOR MYCOLOGIST FOR 1930.

I was absent on leave from the 18th April to the 3rd November.

In February I visited Kericho and Sotik, to inaugurate fertilizer and liming experiments against coffee berry disease; Koru and Songhor, in connexion with the organization of a campaign against striga weed, and Nandi Escarpment, to address a meeting of the local Farmers' Association and to inspect coffee farms.

In November I revisited Kericho and Sotik, to make observations on the experiments begun in February; Songhor, to hold a meeting of farmers to discuss results of the 1930 campaign against striga weed and to make arrangement for a further campaign in 1931; and Nandi Escarpment to see the results of fertilizer treatments against coffee berry disease on certain private estates. During this tour I also visited farms at Londiani, Mau Summit, Njoro and Nakuru in connexion with various wheat diseases, and one farm at Eldama Ravine for observations on coffee berry disease and maize ear rot diseases. At Mau Narok, on my return journey, I inspected indigenous barberries for the presence of rust.

Mr. Edwards, while he was Acting Mycologist, made observations on diseases of coffee at Ruiru and Makuyu, of fruit at Limuru and of sisal at Kilifi.

Correspondence.

Enquiries numbering 176, concerning diseases of forty different host plants and mostly accompanied by specimens for examination, were dealt with.

A considerable proportion of other correspondence related to the working of the anti-striga and sugar mosaic eradication campaigns.

Reports on botanical specimens submitted for identification, matters relating to the administration of the Diseases of Plants Prevention Ordinance, interchange of information with other officers of the Department and with scientific institutions in several other countries also accounted for much correspondence.

Investigational Work.

Owing to my absence on leave during part of the year, scientific investigations were naturally somewhat curtailed. Arrangements were made, however, to maintain the routine side of the more important work.

Wheat.

In continuation of the investigations on physiologic forms (*see* Annual Reports of the Department of Agriculture for the years 1927, 1928 and 1929), tests were made with nine samples of stem rust of wheat (*Puccinia graminis tritici*) collected in various localities and at different times during 1930. The principal object of these tests was the search for new physiologic forms. Eight of the nine samples proved to be either one or the other of the two physiologic forms, K1 and K2, already known to occur in Kenya. The ninth sample, which was obtained from a plot of Reliance wheat at Njoro in September, proved to be a form which had not previously been found in the country. It has been explained in previous reports that different physiologic forms produce distinctive reactions when a range of wheat varieties, known as "differential hosts," is inoculated with them. The method employed, therefore, to detect the different forms is to inoculate the differential hosts in the seedling stage and to compare the reactions obtained with those of the different physiologic forms already known to occur in Kenya. Mr. Evans, who carried out the test with the Njoro sample, reported that two varieties which had always exhibited marked resistance to inoculation with both forms K1 and K2 had on this occasion proved susceptible thus indicating that the sample under test was a form new to the country. The varieties in question were Kanred and Reliance. The result so far as Reliance was concerned was, of course, to be expected, since the sample was obtained from a plot of this variety which had succumbed to stem rust in the field. Both Kanred and Reliance are American varieties, and it has been the experience in America that they always show the same type of reaction when inoculated with the same physiologic form. Results in Kenya are therefore in conformity with American experience, since where one of these two varieties has shown resistance to a Kenya form, the other has done so likewise, and vice versa. The new form will be known as K3.

Since these stem rust investigations were begun in 1927, it has been noticed that Form K1 appears to show a preference for the lower altitudes while Form K2 is more often found in the higher districts. This observation has received further support in 1930, when Form K1 was found in all five tests with stem rust from below 6,500 feet and Form K2 in three out of the four samples from above that altitude, the fourth sample proving to be the new form, K3.

A noteworthy event of the year, of possible significance in connexion with the dissemination of stem rust of wheat was the discovery of the cluster-cup stage of a rust on indigenous barberry at Mau Narok. Extensive areas of this shrub exist in this locality at altitudes of about 10,200 feet. It is probably well known to some wheat farmers that, in temperate climates, barberry is the alternate host of wheat stem rust and that barberries bearing the cluster-cup stage of the rust are an important factor in starting spring infections on wheat. As the result of Canadian investigations, it is also now known that physiologic forms of wheat stem rust may hybridize on barberries and thus give rise to entirely new forms. The discovery of the rust on barberry in Kenya was therefore somewhat alarming, but laboratory examination of infected barberry collected at Mau Narok and experiments carried out since the discovery was made, hold out considerable hope that the rust on the Kenya barberry may prove not to be the alternate stage of that on wheat.

192 routine tests to determine the degree of resistance to Forms K1 and K2 of new hybrid wheat selections bred by the Plant Breeder, were carried out by Mr. Evans.

The 1930 season was notable for the damage done in some wheat areas by foot rot and head blight fungi. Losses from these diseases were particularly severe on certain farms where wheat had been planted following a succession of maize crops. In my absence on leave an investigation of the trouble, which was doubtless accentuated by the unusually wet season, was undertaken by Messrs. Taylor and Maher, whose report, in the form of a bulletin, is in the press.

Coffee.

Fertilizer and liming experiments, based on general pathological considerations, were begun early in the year in an endeavour to discover whether, by such measures, coffee berries could be rendered less liable to contract berry disease (*Colletotrichum coffeanum*, Noack var.). It was considered

that experiments of this kind could be more satisfactorily designed on the basis of the results of a comprehensive soil survey of diseased areas, but, as there seemed little prospect that the required data could be obtained for a considerable time, it was decided to make a start with experiments based on the less exact information available. The co-operation of four coffee planters in affected areas in Kericho and Sotik was obtained and the experiments were planned in consultation with the Senior Coffee Officer and the Assistant Agricultural Chemist (Mr. Gracie). The trials are intended to extend over a three-year period and are being carried out in two series of plots on each farm, one of which is intended for observation on the effects of dressings of potash alone and potash combined with superphosphate, while, in the other series, various quantities of lime are being used. Adequate control plots are also included in each instance.

The fertilizers and lime were applied in February and the plots were visited in November. At that time no appreciable differences were observable between the various plots and their controls. This result, however, was not entirely unexpected in view of the relatively short time during which the experiments had been in progress.

In this connexion it may be mentioned that, in November, on two estates on Nandi Escarpment, where coffee berry disease had been severe in the past, the opportunity was taken of inspecting coffee plantations which, in August, 1929, had received very heavy dressings of artificial fertilizers, including nitrogen, potash and phosphate, combined with farmyard manure and a comparatively small quantity of lime. Intensive spraying had also been carried out on certain blocks. Adequate untreated control blocks had, unfortunately, not been left and so many treatments had been combined that it was impossible to draw reliable conclusions as to the actual causes of the results observed, but the improvement in the appearance of the bushes and the crop compared with what had obtained in the past was most marked. Coffee berry disease had occurred to a certain extent earlier in the season, but it was evident that it had not affected the crop to anything like the extent which had been experienced in previous seasons.

Laboratory experiments have been carried out during the year in collaboration with the Agricultural Chemist (Mr. Beckley) to discover what conditions must be complied with to guard against the risk of disseminating coffee berry disease by the use of diseased coffee pulp in compost pits. The

experiments were carried out over periods of one month and consisted of two main parts. In one case cultures of the coffee berry disease fungus were kept at different levels in two kinds of compost pits prepared by the Agricultural Chemist. One contained coffee pulp alone and the other a mixture of coffee pulp and grass. Temperatures were taken and as a result it was found that the maximum temperatures developed at the bottom, middle and top of the pit containing pulp only were 32, 30 and 29 degrees C. respectively. On removing the culture tubes from this pit at the end of the month, it was found that little growth had taken place. The fungus in the tubes from the top and middle levels, however, soon resumed normal growth at ordinary room temperatures, but the fungus in the tubes from the bottom of the pit was dead. In the other type of compost pit, in which a pulp and grass mixture had been used, temperatures at all levels rose to over 60 degrees C. in two days and remained above 50 degrees C. for ten days. At the end of the month the fungus in the culture tubes was dead in every case.

The other part of the experiment was carried out in the laboratory and was intended to determine more accurately the length of time required to kill the berry disease fungus when exposed to different temperatures. It was found that, under incubator conditions, the fungus survived for twenty-four days at 35 degrees C. although growth was practically nil. As the period of exposure was prolonged up to twenty-four days, the fungus resumed normal growth more and more slowly when subsequently returned to normal temperatures and, after twenty-seven days at 35 degrees C., did not resume growth at all. At temperatures of approximately 40 degrees C. the berry disease in culture was killed within three days, the earliest period at which cultures were withdrawn for re-exposure to normal conditions. It would appear therefore that it is safe to use coffee pulp affected with berry disease in compost pits, provided that conditions are such that a temperature of at least 40 degrees C. is maintained for a period exceeding three days.

Early in the long rains the bark on the stems of a number of coffee seedlings which had been planted out in the laboratory plots under exceptionally heavy rainfall conditions was found to be attacked by a fungus which proved to be a species of *Pestalozzia* and was later determined by the

Imperial Bureau of Mycology as *P. funerea*, Desm. The seedlings did not appear to be suffering any harm as a result of the attack.

Maize.

The discovery of the fungus *Diplodia zeæ* (Schw.) Lev., the cause of an important dry rot of maize ears in South Africa, parts of America and elsewhere, was mentioned in last year's report. It had then only been found on a single dead maize stalk in the Trans Nzoia. In February, 1930, the fungus was found on a dead maize stalk at Koru and proved to be present on maize ears from a discarded heap on a farm at Eldama Ravine. Ears showing the same symptoms were again present in gleanings from the next crop on the latter farm, examined in November. An ear sent in from Rongai in January for examination was similarly affected.

The ears showed the presence of white fungus mycelium, visible to the naked eye, between the rows of grain. Artificial cultures were readily obtained from such material and developed the typical growth characters and fruiting stage of *Diplodia zeæ*. The damage sustained by the ears, however, was much less than that described in the literature of countries where the disease is serious. The ears examined, though light in weight, showed little or no blackening of the germ-ends of the grain or core tissues and the fruiting stage of the fungus was not found on them. It is perhaps too early to hope that the fungus finds conditions uncongenial in the maize areas of Kenya.

During the year observational plots were begun, at the writer's request, to test the effect on germination, early vigour and ultimate yield of maize of treating the seed with certain proprietary dusts. The experiments were put in hand by Mr. Lyne Watt, Agricultural Officer at Bukura, Mr. H. Coltart at Ngata Farm, Njoro, and at the Scott Agricultural Laboratories, Nairobi, by the Agricultural Officers, Messrs. Leckie and Gillett, stationed there. The maize in the plots at Bukura was unfortunately destroyed by hail and, at the moment of writing, results from those at Njoro are not to hand, owing to lateness in harvesting. At Nairobi the plots which had been planted with seed previously treated with Tillantin R, Merko and Abavit B dusts respectively showed no marked improvement in germination or early vigour compared with the control. The ultimate yield from the Tillantin R plot was somewhat greater than that from the control plot

but the result was not sufficiently outstanding to justify a general recommendation to adopt the treatment. The other two treatments did not result in increased yield. It must be borne in mind, however, that the purpose of the dust treatments is largely to check the deleterious effects of certain seed-borne diseases and that these have never been very prevalent at the laboratories.

Barley.

Two experiments on the treatment of barley seed with certain fungicidal dusts as a means of controlling covered smut (*Ustilago Hordei*) were completed at the Scott Agricultural Laboratories during the year and a further experiment of the same kind was undertaken by Mr. H. Coltart of Njoro, to whom grateful acknowledgment must be made for his valuable assistance.

At the laboratories the barley seed used was first heavily artificially infected with smut spores in order to make the tests severe. Tillantin R dust was used in both experiments and K1F (Ceresan) in the second only. Ample control rows of infected but untreated seed were included in each instance. None of the dusts in these experiments gave adequate control; in fact, in both experiments less smut appeared in the resulting crop in the untreated control rows than in those which had been treated.

Mr. Coltart's experience at Njoro, however, was much more encouraging. In this case the seed was not artificially infected. Three adjacent plots of one-third of an acre each were used, the middle one, planted with infected but untreated seed, constituting a control. The seed for the outside plots was treated with Tillantin R and K1F dusts respectively. Observations made when the crop was mature showed about equal amounts of infection (estimated at 5 to 6 per cent) in the Tillantin R and control plots, while only four smutted heads were found in the K1F plot. This number, occurring on one-third of an acre, represents an infection of only a very small fraction of 1 per cent or practically complete control.

Further experiments are contemplated to endeavour to arrive at an explanation of the discrepancy observed between the results obtained with normally and artificially infected seed respectively.

In the Annual Report for 1929 it was mentioned that net blotch of barley, due to *Helminthosporium teres*, Sacc., had been newly recorded and that the presence of another barley disease due to a different species of the same genus of fungi was suspected. The matter was followed up in 1930 and resulted in the isolation of *Helminthosporium sativum*, P.K. and B., from leaves of barley growing at the Scott Agricultural Laboratories. This fungus is the cause of " spot blotch," a disease well known in other parts of the world. Investigations to determine its importance in Kenya will be carried out as opportunity occurs.

Special Work.

During my leave in England I spent a fortnight mainly at the Imperial Bureau of Mycology, Kew, for the purposes of consulting literature not available in Kenya and of discussing various pathological problems of importance to my work. During the same period I also visited the herbarium of the Royal Botanic Gardens, Kew, the Botanical Department of the British Museum (Natural History), and the Imperial Institute, London, the mycological laboratories of the Ministry of Agriculture and of the Rothamsted Experimental Station, Harpenden, and the Imperial Bureau of Agricultural Parasitology, St. Albans. As a result of these visits I was able to gather much valuable information and I desire to express my thanks to the respective directors and staffs for the courtesy and assistance extended to me.

In August I attended the Fifth International Botanical Congress held at Cambridge. This gave me the rare opportunity of meeting personally a number of world authorities in various branches of plant pathology. The agenda of the section of mycology and plant pathology included several papers of special interest in connexion with my work in Kenya, notably on such subjects as stem rust of wheat, maize diseases due to *Gibberella saubinetii* and virus diseases of various crops.

Routine Work.

Anti-Striga Campaign.

A campaign against the parasitic weed *Striga hermonthica* was organized and carried through during the year. The campaign was put into operation at the request of certain farmers who viewed with alarm the spread of the weed on maize farms in the Nyanza Province. The support of the Songhor, Koru and Fort Ternan Farmers' Associations was obtained and a system of inspections of farms in the non-native areas was instituted through the agency of honorary

inspectors, appointed by the respective associations and working under the local supervision of a plantation inspector (Mr. H. R. H. Stone) allocated by the Department of Agriculture. Although I was responsible for the preliminary organization in the earlier months of the year, the brunt of the work at headquarters during the active period of the campaign fell on Mr. D. C. Edwards, Acting Mycologist. The main object of the campaign was to ensure the eradication of the weed before it could set seed and it was hoped to effect this end without recourse to legal action. This unfortunately was found impossible and numerous prosecutions of persons who repeatedly neglected warnings had to be instituted. Summonses under the Diseases of Plants Prevention Ordinance were issued against seventy-five persons (two Europeans, three Indians, one Somali and the rest natives) and seventy-three convictions were obtained.

The co-operation of the Administrative, Railway and Public Works Departments was sought and obtained, to deal with the parasite in the native reserves and on railway and road reserves respectively.

The campaign undoubtedly greatly reduced the amount of seed which reached maturity in the area in 1930 and it is hoped that it also served to inculcate a sense of responsibility to their neighbours in those farmers who had been in the habit of allowing the parasite to go unchecked. At a meeting held at Songhor in November and at which the chairmen of two of the Farmers' Associations concerned and most of the honorary inspectors still actively officiating were present, the value of the work carried out was stressed and proposal for a repetition of the campaign on similar lines in 1931 were strongly supported.

Thanks are due to those who, at considerable inconvenience to themselves, carried out the duties of honorary striga inspectors.

Sugar Mosaic Eradication Campaign.

Owing to the fact that, during inspections in December, 1929, occasional rogues of cane varieties susceptible to mosaic disease were found still to exist in certain blocks of cane in Nyanza Province, it was considered advisable to extend till June 1st, 1931, the period during which the growing of all sugar varieties other than Uba is prohibited. As a result

of a close inspection carried out in December, 1930, the plantation inspector reported that, in his opinion, no further cane of susceptible varieties then existed in the affected area

Small quantities of sugar cane of the varieties of P.O.J. 213, 2725, 2727, BH 10/12, Ba 6032, Ba 11403, and Ba 11569, were issued to growers in the mosaic-free areas. These canes had all been imported after a full period of quarantine either in Uganda or South Africa and had remained free from all major diseases in the laboratory quarantine for sixteen months or more. Plants grown from seed pieces of BH 10/12 issued to a farmer on Nandi Escarpment, nevertheless developed the symptoms of red stripe disease. This variety only was affected and all the plants were immediately destroyed. Other plants of BH 10/12 which were also derived from the laboratory quarantine about the same time but which were planted in Ruiru district have so far shown no sign of the trouble. All the evidence therefore supports the theory of a local infection, possibly from an indigenous grass.

New Plant Disease Records.

The following are new plant disease records for the year.

Coffee (Coffea arabica).
On stems of seedlings, *Pestalozzia funerea* Desm.

Barley.
Spot blotch, *Helminthosporium sativum* P.K. and B.

Apple.
Circular spot, *Phyllosticta pyrina* Sacc.

Garlic (*Allium sativum*).
Rust, *Puccinia porri* (Sow.) Wint.

" *East African Cedar* " (*Juniperus procera*).
Sooty mould, *Hormiscium pinophilum* (Nees.) Lindau.

Cassava (*Manihot utillisima*).
Mosaic, Virus.

Barberry (*Berberis* sp., ? *B. aristata* D.C.).
Rust. *Aecidium* sp.

Sugar (variety BH 10/12).
Red stripe disease, *Phytomonas rubrilineans* Lee et al.
(Organism not isolated.)

Pumpkin (*Cucurbita pepo*).
Leaf spot, *Septoria Cucurbitacearum* Sacc.

Rose.

Leaf spot, *Cercospora rosicola* Pass.

On indigenous grasses :—

Cynodon plectostachyum Pilg.

Rust, probably *Puccinia cynodontis* Desm.

Eragrostis papposa Steud.

Rust, probably *Uromyces eragrostidis* Tracy

Setaria aurea A. Br.

Smut, *Ustilago heterospora* P. Henn.

Brachiaria brizantha Stapf.

Cerebella panici Tracy and Earle following *Sphacelia* sp.

The following types of virus disease of potato were noted in the laboratory plots : Leaf roll, mosaic, crinkle and streak.

It remains to acknowledge the very valuable assistance received as usual from the directors and staffs of the Royal Botanic Gardens and the Imperial Bureau of Mycology respectively.

J. McDONALD,
Senior Mycologist.

APPENDIX VI.

ANNUAL REPORT OF THE SENIOR AGRICULTURAL CHEMIST, 1930.

SUMMARY OF WORK DONE.

Inward letters	737
Outward letters	680
Reports on samples, etc.	658
Personal interviews	350

Publications : 4 bulletins (*see* general list).

SAMPLES EXAMINED.

Nature	Outstanding at 31–12–29	Received	Examined	Refused	Outstanding at 31–12–30
Dips	..	590	579	11	..
Soils	50	200	242	8	..
Fertilizers ..	..	20	19	1	..
Toxicological	..	66	62	4	..
Wireworm Remedy ..	..	30	30	..	..
Waters ..	..	12	9	1	2
Essential Oils	..	29	23	..	6
Kresotow ..	..	27	27	..	..
Wattle Bark ..	..	6	6	..	..
Sugar Cane ..	..	5	5	..	..
Coffee ..	..	62	62	..	..
Feeding Stuffs	1	46	47	..	..
Edible Earths	..	2	..	..	2
Miscellaneous	..	57	57	..	..
	51	1,152	1,168	25	10

CATTLE DIPS.

The number of dip samples received has remained about the same as last year. In the report for last year it was stated that there had been an improvement in the labelling of dip samples, this year it has to be reported that there has been a retrogression. Every sample of dip should be sent in a proper box and have attached to the bottle a label stating the name of the sender, the number of the dip and the nature of the dip wash.

Results of Analyses of Dip Washes.

Extent of Error	1927		1928		1929		1930	
	No.	%	No.	%	No.	%	No.	%
Within 1 %	38	5·9	30	5·8	39	6·5	32	5·5
Between 1 % and 5 % ..	119	18·4	81	15·8	98	16·3	67	11·6
Between 5 % and 10 % ..	95	14·7	103	20·1	107	17·8	107	18·5
Between 10 % and 20 %	170	26·3	127	24·8	168	28·0	142	24·5
Over 20 %	216	33·5	172	33·5	187	31·4	231	39·9
Too dirty to analyse ..	8	1·2	..	..	..	..	..	..
	646	..	513	..	599	..	579	..

There has been a marked increase in the number of samples dangerously incorrect. Probably this is mainly ascribable to the heavy rains causing flooding of the dipping tanks; nevertheless, it all points to the fact that the strength of the dipping fluid is not properly controlled. Too many dip owners depend upon the occasional free analysis performed at the laboratory for the correction of the hit-or-miss methods normally employed. It is, in the opinion of the writer, essential for every dip owner to own and use regularly one or other of the dip testers and to maintain his wash at the desired strength. The two testers in use in the Colony suffer from the defect that it is difficult to obtain accurate results. A set of apparatus has been designed and at the writer's request is now being stocked by Messrs. Simpson and Whitelaw, of Nairobi. This set, while not so portable as the others, is easy to use and gives accurate results.

Besides using a dip tester one must know the volume of the dip wash in the tank. So often during the past year has it been demonstrated that the dip owner has not the slightest idea of the volume of his dipping tank. If dip tests are to be of any value, it is essential that the volume of the fluid be known. A stick marked in hundreds of gallons should be made for the tank and stored in the roof of the tank.

Toxicological.

The number of toxicological samples received this year is greater than last year, when a large number were due to the locust campaign. This year only a few could be directly ascribed to it. Contrary to the experience of previous years, practically every sample gave a positive test for arsenic. The need for careful handling and storage of arsenicals cannot be stressed too much. Arsenic is a very powerful poison and

once it has been absorbed into the system, it cannot be combated. Every care should be taken to prevent accidental distribution of arsenical solutions. Even more care must be taken that arsenical concentrates are properly and safely stored. One case of indubitably malicious poisoning by arsenic came within the notice of the writer during the period under review and more than probably the arsenic was stolen.

Waters.

The only point worthy of record among the water analyses is that of a water obtained from a borehole at Kikuyu. This water contained a remarkably large amount of zinc in solution. The zinc can only have been obtained subterraneously, and not from contact with pipes or other zinc-covered metal.

Feeding Stuffs.

During the past year a number more feeding stuffs have been analysed. The results of these analyses, together with those published last year, are given below.

Feed	Moisture	Ash	Crude Protein	Ether Extract	Crude Fibre	Nitrogen Free Extract
Simsim Cake, Average of six Samples	9·4	8·6	36·8	16·7	5·2	23·3
Ground-nut Cake	12·3	4·0	39·5	11·8	4·7	27·7
Adult Locusts, Dried ..	6·7	9·0	46·4	17·2	20·7	
Meat Meal, Average of two Samples	9·1	2·7	72·2	11·8	1·0	3·2
Rice Dust, Average of two Samples	12·0	7·8	10·3	12·1	4·7	53·1
Bran	12·5	4·3	15·8	3·9	10·0	53·5
Pollard	13·3	3·6	15·6	4·4	8·7	54·4
Maize Meal	12·6	1·2	10·0	4·7	2·0	69·5
Edible Canna, Fresh ..	86·0	0·8	1·1	0·03	0·7	11·4
Malva verticillata	67·5	4·7	6·6	2·1	6·2	12·9
Couch Grass Hay	9·6	10·8	16·0	1·6	22·7	39·3
Paspalum notatum	6·9	11·5	8·1	1·7	29·8	42·0
Paspalum dilatatum ..	9·0	8·8	7·5	2·1	29·7	42·9
Panicum trichoclodum ..	7·1	8·2	6·8	1·5	41·0	35·4
Panicum meyeriarium ..	7·4	10·8	7·6	0·9	39·9	33·4
Panicum maximum	8·3	11·7	5·4	0·8	41·2	32·6
Panicum coloratum	9·0	6·4	5·4	1·1	41·8	36·3
Pennisetum clandestinum ..	10·0	8·7	11·3	1·1	31·1	37·8
Pennisetum ciliare	9·6	9·4	11·1	0·9	34·3	34·7
Themda triandra	10·8	7·1	4·3	0·7	42·3	34·8
Melinus minutiflora	6·2	7·4	5·3	1·4	40·9	38·8
Chloris gayana	9·0	9·3	8·3	1·0	40·1	32·3

A number of these analyses were made last year and commented upon in last year's annual report. Some others are of such well-known feeds as not to require comment.

The crude protein figure for edible canna is rather higher than was expected from the nature of the crop. A further determination revealed the fact that rather less than half of this was true protein. Nevertheless, it is a valuable fodder, especially when used in conjunction with a feed rich in protein.

Malva verticillata is a mallow-like plant common around Naivasha. The analysis shows it to be a valuable fodder, confirming the opinions of stock owners in that neighbourhood.

The analyses of the grasses refer to the grasses in an air-dry state. Some have a very high crude fibre content, but this is explained by the fact that in most cases the grass was cut in the flowering stage when the crude fibre content is higher than in earlier stages. The high crude protein content of the two pennisetums is worthy of note. Further analyses of grasses, especially in collaboration with the Agricultural Officer in charge of Grassland Investigation, have been planned for the coming year.

Essential Oils.

The work on essential oils commenced last year has been continued, and upon the experience gained a bulletin has been prepared including an appendix, written in conjunction with Mr. T. L. McClelland, upon the apparatus for distillation. This bulletin will appear during the coming year.

Of the numerous plants examined, only a few promise to prove of value to farmers in Kenya. These are geranium, cedar wood, lemon grass, and the two eucalypts, *E. globulus* and *E. citriodora*. As yet unproved are peppermint and lavender. A few indigenous plants are of great promise but their oils are unknown upon the European market. Quantities of these are being prepared for submission to the Imperial Institute for report.

Geranium requires no comment beyond impressing upon intending growers the absolute necessity of obtaining a good strain of geranium. The common variety in Kenya produces a low-grade oil.

East African cedar wood oil is hardly known on the European market. It is entirely different from American cedar wood oil but it appears probable that, on account of its

odour, it will occupy a position of its own. The price of American cedar wood oil in December, 1930, was Sh. 1/6 per pound on the English market, and this is the price that would probably be obtained at first. A quantity of cedar leaf oil is being produced at the request of one of the London importers of essential oils. This oil may prove sufficiently remunerative to justify the distillation of the leaves and twigs usually wasted in cutting.

Lemon Grass.—A very good report has been obtained upon a sample of lemon grass oil distilled at the laboratory. The odour value and the light colour of the oil in particular were commented upon. Cochin lemon grass oil, which is the principal grade sold upon the European markets, now commands a price of Sh. 2/4 per pound. As it appears that an annual yield of about 100 lb. of oil per acre can be obtained, lemon grass should be a profitable crop upon the cheaper grades of land.

Eucalyptus globulus.—A small sample distilled in the laboratory has been valued at Sh. 1/2 per pound c.i.f. London. In producing this oil care would have to be taken that only *E. globulus* was distilled and that there was no admixture of other species. In all probability, as a side line, *E. globulus* oil could be produced at a fair profit, as a yield of over 1 per cent was secured in the laboratory distillation.

Eucalyptus citriodora.—The oil produced in Kenya from *E. citriodora* is quite different in odour from that produced in Australia and would have to be used for a purpose other than that of the Australian. The price it would command would be less than that commanded by Australian oil, which to-day stands at Sh. 5 per lb.

Peppermint.—In 1915 a sample of peppermint oil, distilled from plants grown at Molo, was most favourably commented upon and the opinion was expressed that Kenya would probably become an important source of peppermint oil. Since then, however, the stock at Molo has disappeared. Recently plants have been otained from Mitcham and are now being multiplied at the Scott Agricultural Laboratories whence distribution to selected areas will be made in 1931. Attempts are being made to obtain Japanese peppermint from which an oil very rich in menthol is produced. The oil from this variety is very valuable and there may be a difficulty in obtaining plants.

Lavender.—During the year a small sample of lavender flowers from the Kinangop was distilled. The species of lavender was unknown, but the oil had all the characteristics of the oil of spike lavender. The odour, in the writer's opinion, was much to be preferred to the commercial spike lavender oil. A small lot of seed of true lavender from Mitcham was obtained and has been distributed to a number of possible growers at the higher elevations. The first distillation will be possible in 1931.

In addition to these exotic plants under trial, two local woods are of promise, *Muhugu* (*Brachylæna Hutchinsii*), and what is believed to be a species of *Spirostachys*. Sufficient of the former oil has been accumulated to permit of the despatch of a sample to the Imperial Institute. The Muhugu oil is a heavy pale yellow oil having a vetivert-like odour and it should be valuable. Only a very little of the *Spirostachys* oil has as yet been produced, it is an oil heavier than water, very viscous and highly odoriferous. The odour is reminiscent of East African cedar wood, sandal wood and Russia leather. It is very probable that this oil will prove to be of great value in soap perfumery and will command a good price.

Ocimum canum, which was mentioned in last year's report as containing camphor, is now being cultivated. Information has been received from London that a small quantity, about half-a-ton, of camphor from this source is now on the market. The camphor has been valued at Sh. 1/5 per pound.

Satisfactory as most of these reports have been, it will be evident to all that the production of essential oils is not a highly remunerative undertaking, except perhaps in the case of some few that will be found to be very selective in their environmental needs. Generally it will be found that essential oil production is about equivalent in the profit per acre to profitable maize or wheat farming.

Kresotow.

The work upon this subject for mealy-bug control has been carried a stage further. No satisfactory alternative source of the ant repellent has yet been discovered. The specification which has been evolved for the oil should, unless something most unforeseen occurs, ensure that a uniformly satisfactory product is obtained.

The field tests conducted this year have amply demonstrated how difficult a subject is that of repellents. From the results of last year's field trials, it appeared that we were

in sight of a solution of the problem. A number of oils other than coal tar oils were tried and their repellent properties were exactly what was expected. Those that were expected to have no repellent properties were crossed by ants within a few hours, partial repellents lasted for a few days, while true repellents lasted many weeks. This year, conditions were very different. Oils that, according to hypothesis, should have had no repellent properties and should have been crossed in at most three days, even identical oils that were ineffective last year, proved to be almost as effective as the true repellents in preventing the ants from crossing the bands. The true repellents, on the contrary, were crossed in about seventy days; last year some of these were still effective after one hundred and forty days. No explanation for this behaviour can be offered or even attempted, but it is distinctly annoying and will necessitate repeating the whole series of field trials during the coming year when it is hoped the ants will behave in a more rational manner. If this does happen, then it will be possible to close the investigation.

Samples of the Kresotow imported during the year have been tested and found to comply with the specification.

Field trials of cellophane strips have been made during the year and in no case have they been found to break down. The material has been imported by one of the local firms.

Coffee Fermentation.

There has been a fair demand for cultures of the bacterium used to speed up the course of fermentation. No complaints have been received regarding the bacteria. Probably the method of preparing the inoculant is now fully understood.

Before the scientific publication of the observations made during the study of coffee fermentation, one or two practical cases require investigation. This will be done in the very near future, when the investigation may be considered complete.

Soils.

Since the staff of the Division has been below strength for the greater part of the year, it has not been possible to continue the work on the soil survey of the Colony. It is hoped that during the early part of next year the staff will be strengthened by the Soil Chemist, the greater part of whose time will be devoted to the development of this project and to cognate investigations.

Of the 250 soil samples examined this year, only a very few have been routine samples, by far the greater part have been examined in connexion with various soil investigations.

Green Manure Plots.

The effect of continuous clean cultivation and continuous green manuring upon the nitrogen and carbon content of the soil was not so marked as was expected. The soil at the commencment of the experiment was in high fettle, having been continuously under green manures for some years previously. Further tests upon the physical state of the soil are in hand, but the results of these are not yet available for inclusion in the report.

During the long rains the value of green manuring was most markedly shown. All the plots kept clean suffered very severely from wash, losing about four inches of surface soil. The green manure plots, even between crops, stood up wonderfully. The green manuring has increased the power of absorbing water which largely accounted for the small amount of wash.

Coffee Berry Disease.

As the result of some preliminary analyses of diseased and normal coffee, it appeared probable that there must be some relationship between soil conditions and the incidence of the disease. A preliminary investigation upon the soils from four plantations has been commenced to permit of the planning of the proper investigation. From the first results of this preliminary investigation, it is evident that the relation is not a simple one. In some cases the incidence of the disease will be worse on land where the soil acidity is high, while in other cases the converse will hold. Neither is there any relation between the lime content of the soil and the incidence of the disease. Much more complete analyses will be required before the main investigation can be fully planned.

The problem is a difficult one requiring close team work between mycologists and chemists. On the chemical side it will be necessary to attack the problem from two points. An intensive study of the soils and soil conditions in the areas where coffee berry disease is prevalent will be required, together with a survey of the incidence of the disease. At the same time it will be necessary to make a biochemical study of the variations in the composition of the developing

coffee cherry under conditions conducive to this new development of the disease and under conditions where there is no disease. Under such conditions it is evident that progress may be slow.

Soil Conditions in Kikuyu Reserve.

The methods of agriculture in the native reserves often are adversely criticized. More often than not, the methods employed are more suited to the conditions than those suggested; any change in methods would involve the use of manures and fertilizers, which at present are out of the reach of the native cultivator.

A certain amount of work has been done on the soils of the higher parts of the South Kikuyu Native Reserve, particularly upon a very friable pulverulent type of soil. The natural vegetation upon this soil is a low scrub in which, very often, bracken is the dominant plant. After clearing, the bush is burnt and a regular succession of crops is grown over a period of three years, after which the land is allowed again to regenerate bush. This rapidly shifting cultivation at first sight appears to be very wasteful but without relatively considerable expenditure it is very much to be doubted if the system could be altered. When first cleared, the soil contains a great deal of humus and has a well developed crumb structure. The second year the crumb structure has decreased considerably and the soil does not absorb water so readily. After this the structure breaks down rapidly and the soil becomes dusty. In one series of samples the following results were obtained for exchangeable lime, which may be taken as a measure for the replaceable bases in the soil :—First year 0.84 per cent calcium oxide, second year 0.58 per cent calcium oxide, third year 0.45 per cent calcium oxide. It is thus evident that with the breaking down of the humus there is a rapid loss of plant nutrients. In the soil profile it was only possible to obtain one on account of the suspicions of the natives, there was a very rapid decrease in the amount of exchangeable calcium with depth.

In order to maintain a good yield it would be necessary to use manures liberally. In the area in question there is no grass so there is no dung available. It will become essential if any alteration in the system is to be made for composts at least to be employed; it will be some time before the native cultivator will make this a practice. Any radical change will involve the use of artificials, notably phosphatic and potassic

manures and this the native will not do for many years. There is no alternative to the system now practised, allowing bush to be regenerated and thus increase the supply of minerals in the surface soil.

Manures and Fertilizers.

Most of the samples under this head have been taken in connexion with investigations or experiments. During the year a good deal of artificial farmyard manure has been made. That produced during the long rains suffered from the rain and a good deal of the plant nutrients was lost by leaching. In order to compare methods of making artificial farmyard manure, both pitted and stacked manure have been prepared, the latter purely experimentally. One of the stacks, which were of wheat straw, received "Adco," the other a mixture of rock phosphate and sulphate of ammonia as described in Bulletin No. 10 of 1930. A thermometer was placed in each heap.

Decomposition set in rapidly and in a day or two a faint smell of ammonia could be detected on each heap. Probably, if the stacks had been covered with soil, the loss of ammonia may have been prevented. The temperature in the heaps rose rapidly; in one heap it rose 40 degrees C. (104 degrees F.) in two days. The maximum temperature reached was 70 degrees C. (158 degrees F.) After fifty-five days the heaps were opened and it was found that parts had rotted completely to a dark brown mass; parts, however, were quite dry and untouched. This was to have been expected as after each shower of rain the temperature in the stack rose appreciably, indicating that there was still a good deal of material undecomposed and needing wetting. It is evident that in stacks great care must be taken to saturate the stack thoroughly, that it should be wetted at intervals during the rotting and that it should be thatched or covered with soil to conserve moisture. An experiment has been laid down to ascertain the relative values of farmyard manure and the two artificial manures prepared.

The possibility of destroying pests and disease spores in the raw materials of the heap is being investigated in collaboration with the Mycologist. The results of this experiment will be reported elsewhere.

General.

Under this heading are included several minor investigations and duties which are not considered requiring a special heading.

Attempts to obtain an artificial food for lady-birds were continued without any marked success. The insects would feed upon the food but would not thrive nor did they reproduce. Success with an artificial food as our knowledge stands at present and with the resources available will be purely accidental. Nothing is known of the composition of the portion of the mealy-bug eaten by lady-birds and in order to obtain this knowledge some thousands of mealy-bug would have to be carefully dissected to obtain the material for analysis, a labour which cannot be justified. An unsuccessful attempt to procure an artificial food for mealy-bug and thus for lady-birds was also made.

Work upon insecticides has also been continued. Methods of utilizing the toxic principles of pyrethrum (*Chrysanthemum cinerifolium*) and of *Tephrosia Vogelii* have been developed but unfortunately neither of these can be applied by the planter but demand the resources of a chemical factory. Analyses for the most toxic principle in pyrethrum have been made upon pyrethrum grown at the Scott Agricultural Laboratories, with very satisfactory results.

The material obtained from *Barringtonia racemosa*, referred to in last year's report, has been handed over to the Biochemist of the East African Agricultural Research Station, Amani, for investigation. Probably the toxic principle is allied to that of derris.

During the year a certain amount of time has been devoted to methods of analysis. Many of the usual methods are either expensive or are not fully applicable to the soils of the tropics. Several new methods have been evolved and tested, some with gratifying results. After a little more study it will be possible considerably to speed up work and considerably to save upon the cost of chemicals, etc., without sacrifice to accuracy.

A good deal of the time of the writer has been taken up in what may be best described as consultative work. Wherever the advice or the work of a chemist has been required by other members of the staff, this, as far as possible, has been given. Although such work involves a good deal of time, it is considered to be time well spent.

Finally I wish to record my appreciation of the loyal work of Messrs. McNaughtan and Phillips, the two laboratory assistants in this Division.

V. A. Beckley, *Senior Agricultural Chemist.*

APPENDIX VII.

ANNUAL REPORT OF THE SENIOR PLANT BREEDER FOR 1930.

I was absent from the Colony from February to November. Mr. Lathbury took over my duties, assisted by the normal small number of officers on the staff, except in the case of the work at the Scott Agricultural Laboratories, where the absence of the assistant on leave caused the work to fall on the agricultural officer at the Laboratories, Mr. S. Gillett, without whose assistance in performing this as well as his own work, it would hardly have been possible to preserve the continuity of the work.

During my leave ten weeks were spent on a study of agricultural (chiefly plant breeding) problems at various institutions in Great Britain, Germany, Canada and the United States of America. A report on this has been submitted.

The work covered by the Plant Breeding Services may be divided into the following sections :—

(*a*) Wheat breeding.
(*b*) Maize breeding.
(*c*) Experimental work.
(*d*) Crop production studies.

The report on the maize breeding and investigational work has been written by Mr. Maher. Whilst concentrating mostly on maize work, this officer also carried out the duties of agricultural officer to the station in lieu of Mr. Spranger, on leave.

Wheat Breeding.

General.—The year under review has been a poor one for wheat growing. In most areas too much rain fell on the crop, whilst the spread of disease was assisted by the excessively moist soil and atmospheric conditions experienced. Root and foot rot Fusarium diseases, not hitherto recorded in the Colony, were responsible for much damage, in some cases causing the total destruction of the crop. Infection was caused either through the soil, particularly when maize had been the previous crop, or by the use of infected seed. Glume Blotch and Black Chaff, either by themselves or together with the above, were also present and added their quota of damage.

Yellow Rust was epidemic throughout the country, extending to below 6,000 feet. This is a very rare event, as it has only once before been recorded at such a low height. Stem Rust as usual was present and was alone responsible for the destruction in some cases of fields of Kenya Governor and Equator. Leaf Rust was also prevalent, especially on Kenya Standard.

Wheat in this country is unfortunate in being exposed to a large number of diseases, most of which are capable of damaging the crop severely, and it would appear that they have all combined to do their best or worst this year. As a result, farmers generally have reaped small crops, and small yields likewise have been obtained at the Plant Breeding station. All those adverse factors have not facilitated the breeder's work of selection and breeding.

The wheat industry is differently placed to that of other countries, even to that of other industries in the country, inasmuch as it has possessed no variety resistant to Stem Rust. This means that any susceptible variety is always liable to be destroyed completely by this rust. In the past this fate has befallen Kenya Governor and Equator, the two varieties commonly grown, and large acreages of these two varieties have again been affected this year.

The plant breeder therefore has not merely to improve on the wheats in use as is the case in most other countries, but he has first got to ensure that all new wheats are resistant to rust. Kenya Standard was bred firstly for this purpose and was issued to the farmers in the country. It has since shown its resistance to Stem Rust wherever it has been grown, but it has not proved to be a particularly good yielding wheat under wet and adverse conditions. In 1929 both on the Plant Breeding Station and at the Scott Agricultural Laboratories it gave ten bags to the acre, whereas this year only half this yield was obtained at Njoro. Except for the immediate necessity for a wheat resistant to Stem Rust, Kenya Standard would probably not have been issued, at least until after a more prolonged trial. It is still expected to be a useful wheat in normal seasons.

Further new wheats are now in course of multiplication, all of which are resistant to Stem Rust.

In 1928 eighty wheats which had been bred at Njoro and which may be called " Njoro wheats " were issued to farmers. A number of these have since been discarded and the balance

may be divided into those resistant and those susceptible to Yellow Rust. One hundred bags of seed of the former class should be available for sowing this coming season. These wheats are being grown at high altitudes, and whilst, on close inspection, Yellow Rust in the ear could be found, yet the general infection has been so small as to be negligible. This too in a year when Yellow Rust is rampant and when rusted spikelets have been found even in Equator, a wheat which has always been regarded as immune to this rust and, in fact, has never before shown more than the merest trace. It is hoped that these wheats will take the place of Equator when necessary.

Two hundred bags of seed of the latter class should be available. These wheats, whilst susceptible to Yellow Rust at the higher altitudes, are sufficiently resistant to be grown at 7,000 feet, and are suited to districts with a prolonged rainfall, such as the Nakuru district.

All of these wheats take from five-and-a-half to six-and-a-half months to mature. They will yield much heavier than Kenya Standard and should replace this wheat except where a very quick maturer is required. A yield test by the half-drill strip method will be laid down in 1931 between one of these Njoro wheats and Equator. The Equator will be dusted with a sulphur preparation to avoid possible damage by Stem Rust affecting the yield. Their milling quality has been favourably reported on at Cambridge. These wheats have a tendency to lodge on the richer soils. It is of interest to note that the work of breeding these wheats was started in 1922 at Messrs. Sewall and Wright's farm at Njoro.

Five hundred to six hundred bags of a new wheat No. B.F4.2.D. 30.B.2.(L) similar to Kenya Standard in growth, should be available in March, 1931. The wheat is likely to yield better than Kenya Standard though it is not what might be called a big cropper. Like Kenya Standard it is susceptible to Leaf and Yellow Rusts.

The issue of Kenya Standard was rushed as the country did not possess a suitable wheat, but it would seem politic to delay the eventual issue of these new wheats until they have been thoroughly tested over a number of seasons, even though it means a further delay to the farmer.

Amongst the progeny from the new crosses made at Njoro this year, the object is to obtain wheats of varying maturity resistant to both Stem and Yellow Rusts. The

Stem Rust resistant parents used are two of the new Njoro wheats and Kenya Standard. The main fault of the former is their low bushel weight of 56–60 lb., and Kenya Standard rarely exceeds 60 lb. Equator and a type selected out of Australian Florence are the Yellow Rust resistant parents. Both of these wheats have high bushel weights and also yield heavily. The Njoro wheats and Kenya Standard are pure lines from hybrids bred in this country and have not been available in the past.

Resistance to Yellow Rust is an exceedingly difficult problem. Humidity and temperature play an important part and a variety of wheat which shows resistance at, say, 18 degrees C. may be susceptible at 14 degrees C., whilst another variety may be resistant at this latter temperature and susceptible below, say, 10 degrees C. Thus slightly different conditions of humidity and temperature between two neighbouring farms, growing the same variety of wheat, may be the cause why the wheat rusts on one farm and not on the other.

Some of the newer crosses made at the Scott Agricultural Laboratories have as their object the production of quick-maturing wheats resistant to Stem and Leaf Rust. Plants out of the F4. generation of some of these crosses have been selected which are completely free from Leaf Rust, though the leaves of the surrounding plants are covered with it. These selected plants have also shown themselves resistant to the form of stem rust which has been present (K.1.). It is hoped that some of them will also prove resistant to the second form (K.2.). They have strong straw and really excellent ears.

Stem Rust in Wheat.—The ordinary routine work of inoculating large numbers of new wheats with both physiologic forms of Stem Rust known in the country has been taken over by the Plant Breeding Services. Two large muslin cages were erected at the Scott Agricultural Laboratories and the work has been carried out by the Agricultural Officer stationed there. A large number of new wheats, all of which had reached the multiplication stage, have been tested. Only those cultures which showed themselves sufficiently resistant to both forms of Stem Rust were kept and grown on. In some families forty or fifty strains have been kept going. These strains all appear similar except for their resistance or susceptibility to Stem Rust. As a result of the inoculation

tests all the resistant strains are bulked and grown on in a multiplication plot for eventual issue, if satisfactory in other respects.

The rust selection work in the breeding cage is dependent on whether the wheats have been exposed to both forms of Stem Rust or to one form only, which form may frequently appear for several seasons running. Hence a number of wheats are kept going which ultimately, as a result of inoculation, show themselves susceptible to the form which was not present whilst they were being grown in the cage, and have therefore to be discarded.

Next year, however, an artificial epidemic of both forms of Stem Rust will be introduced into the breeding plots, which will largely obviate the need for seedling inoculation, and will enable the Plant Breeder to reduce the number of wheats which, under the present system, it has been found necessary to keep going.

In last year's Annual Report it was stated that an American wheat called Reliance had been grown in this country. This wheat had been tested by the mycologist and found to be resistant to Stem Rust. As a result a bag of seed was obtained and sown at Njoro. The wheat grew well, but was badly attacked by Stem Rust. Some of this rust was sent to the mycologist and up to date it would appear likely that a third physiologic form has appeared, though this has yet to be confirmed. A possible explanation may be that Reliance wheat shows resistance in the seedling stage only.

Neither Kenya Standard nor any of the new rust resistant wheats were affected. It is not confirmed yet whether they are resistant, or merely escaped attack.

Below will be found some description of the breeding work being done at the main Plant Breeding Station and its two sub-stations. A detailed report of work of this nature is difficult to put into words, apart from being of little interest to the layman, but it is hoped that some idea may be obtained of the nature and amount of the work involved.

Scott Laboratories Plant Breeding Station.

Eight F.3. families of hybrid wheats comprising 343 cultures were sown in the cage in the long rains and the F.4. generations from the plants selected at harvest were again sown in the short rains. These crosses were made in 1928 and reference to the Annual Report for that year will show their parentage.

Some of these cultures are now pure and some very promising plants have been obtained. In each family Kenya Standard has been one of the parents. The form of Stem Rust known as K.1. only has been present at the Scott Agricultural Laboratories whilst successive generations of these wheats have been growing. All these cultures have therefore proved resistant to this form of Stem Rust and their resistance to form K.2. will be tested next year by an artificial infection of this form. Since, however, in one family, both parents are resistant to this form, all the selected cultures in this particular group should be resistant to both forms of Stem Rust. Three other families contain some cultures which are completely resistant to Leaf Rust, as has already been mentioned. In addition they possess strong straw and excellent ears.

It would appear, therefore, provided some of these wheats also show themselves resistant to the second physiologic form of Stem Rust, that quick-maturing wheats resistant both to Stem and Leaf Rust and of a large yielding capacity will be available in the future.

Eighty wheats which had come true to type were sown in small yield trial plots in quadruplicate. Where seed was available some of these were also grown in multiplication plots. Stem Rust was exceedingly bad this season at the Scott Agricultural Laboratories and the majority of these wheats were discarded as not possessing sufficient resistance. The few very resistant cultures kept are being multiplied again these short rains. Whilst they should yield better than Kenya Standard they do not appear to possess the yielding capacity of the new hybrids mentioned above. They are also, like Kenya Standard, susceptible to Leaf Rust.

Two hundred and thirty-three cultures of the natural hybrids found in Kenya Standard were sown in the long rains. A number of these were discarded and ninety cultures only have been kept going during these short rains. These cultures have come true to type and a number will now be able to be bulked. They have all shown themselves resistant to Stem Rust (Form K.1.) and are distinctly promising material, being superior both in size of ear and appearance of grain to Kenya Standard.

Two hundred and twenty hybrid cultures of a further family were also sown and fifty-one of these cultures were

selected and have been sown again in the short rains. These will be able to be bulked into three groups and may prove of value.

The experiment laid down in the short rains of 1929 to see whether the strain of B.286 known as B.286 C. might prove to be a better yielder than B.286 itself showed no significant result, and B.286 C. was therefore not kept separate.

To obtain pure seed of Kenya Standard, one hundred and fifty single plants were selected and a fresh stock of seed can be started off, from all those plants which breed true to Kenya Standard type. Should the natural hybrids found in Kenya Standard be found suitable for issue this seed is not likely to be required.

Some three acres of the new wheat No. B.F.4 2.D. 30 B.2. (L) have been sown both these seasons for multiplication and observation.

Njoro Plant Breeding Station.—Following last year's practice, all wheats were sown in the big rains at the end of April so as to receive the benefit of the real growing season. Harvesting took place in September and October, and whilst part of September was wet, October was dry. This year wheat sown in June grew better but generally early sowing would appear to be recommended at Njoro.

Some 85,000 plants, mostly of the F.2. generation were sown in the cage. They consisted mainly of some of the new Njoro wheats which are resistant to Stem Rust, and in some cases also to Yellow Rust, and which had been crossed with wheats such as Marquis to improve their milling qualities and their straw. Three F.2. families bred at the Scott Agricultural Laboratories and which were to be found too slow maturing down there were also grown at Njoro. Single plant selections have been made from the best of all these cultures.

In addition, the F.1. generation of crosses made to improve the rust resistance and yield of some of these new wheats have been grown on.

This year a large number of crosses have been made at the Plant Breeding Station with the object of eventually producing wheats resistant to both Stem and Yellow Rusts. I have already referred to these new crosses in my general remarks.

In addition some wheats selected at Cambridge from a world collection growing there, and which have since shown themselves resistant to Yellow Rust, were also utilized. In all, eighteen separate crosses were made.

The progeny of all those crosses which matured sufficiently early have been sent down to the Scott Agricultural Laboratories where they are being grown on twice yearly.

Some of the Florence types resistant to Yellow Rust were also found to have very little Stem Rust last year. Single plant selections were accordingly made and sown. All, however, showed too much susceptibiity to Stem Rust this season and have been discarded.

Trial Plots.—A large number of cultures of hybrid origin were sown for trial and observation. These mostly represented three families. Many of the cultures came true to type and will be bulked as soon as their Stem Rust resistance is definitely known, though none of these cultures have shown themselves susceptible in the field.

A few imported wheats mainly from Burma and Iraq were sown, but all were susceptible to Stem Rust. The following Australian wheats: Duri, Linden, Burrill, Ford Geeralying and Early Bird, were received too late to sow this year and will be tried next year. Australian wheats are well suited to the country agronomically and the best of these wheats will be used in further crosses to be made next season.

Multiplication Plots.—As a result of the seedling inoculations carried out at the Scott Agricultural Laboratories during the early part of the year, a number of strains of wheat from the same families were able to be bulked together and plots covering several acres were sown for multiplication. I have already mentioned that three acres of Reliance wheat was sown but, owing to Stem Rust, this wheat has had to be discarded.

Yield Trial Test of a New Wheat.

A new wheat tried for resistance to Stem Rust at the Scott Agricultural Laboratories No. B.F.4 2.D.30 B.2 (L) was tested for yield by the half-drill strip method, using Kenya Standard as a control.

In this method the seed hopper of the drill is divided into two halves, so that four drills of the new variety and of the control are seeded at the same time. Both varieties were

harvested separately and their yields statistically treated. The area of the plot was such that after allowing for border effect half an acre of each variety was harvested. The new wheat No. B.F.4 2.D.30 B.2 (L) gave a significant increase in yield over Kenya Standard of 23 per cent. Kenya Standard yielded just over five bags to the acre. It is possible that in a normal season the result obtained might not have been the same, as Kenya Standard does not show to advantage in a wet year. This wheat is suited to an area such as Machakos where a quick-maturing Stem Rust-resistant wheat is wanted. The milling qualities of this wheat are not yet known, but a preliminary strength test has shown that it is the equal of the best No. 1 Equator in this respect.

Mau Summit Plant Breeding Station.

The following wheats were sown in the breeding cage so that their resistance to Yellow Rust could be observed :—

145 hybrids from Kenya Standard.

197 wheats bred at the Scott Agricultural Laboratories.

22 of the new Njoro wheats.

7 imported wheats.

4 types out of Australian Florence wheat.

1 F.2. family with a Stem Rust resistant wheat and Equator as the two parent wheats.

In all nearly four hundred wheats were sown. A small multiplication plot of one of the Njoro wheats was also sown.

Two out of the four types from Australian Florence have already been used in crosses and all four types were again immune to Yellow Rust.

All the wheats bred at the Scott Agricultural Laboratories proved too susceptible, as did most of the Kenya Standard hybrids. A few of these, however, showed a fair degree of resistance and are to be grown on again.

Some of the Njoro wheats again showed themselves resistant to Yellow Rust.

Most of the imported wheats were resistant to Yellow Rust.

MAIZE BREEDING AND MAIZE PRODUCTION STUDIES.

The fact that 1930 was characterized by a rainfall considerably in excess of the average, in all districts, had a great influence in raising yields in the drier maize-growing areas, but the heavy rains after planting in many cases, by facilitating the growth of parasitic organisms, deteriorated the maize in the Trans Nzoia, which has an ample rainfall in most years.

Considerable attention was paid to the effect of the various diseases of maize in reducing the yields, both by reduction of stand and by subsequent but less obvious attacks leading to reduction in general vigour of the crop. The importance of this aspect of maize-growing is being realized more and more by farmers, the majority of whom now make some effort to select seed with special regard to healthiness. The necessity for this effort is perhaps greater in Kenya than in any other maize-growing country, since the custom of growing maize continually is almost universal amongst the maize-growers of the Colony. At the same time, the economic soundness of the introduction of a green crop into the rotation is now appreciated by some farmers.

It was apparent in 1930 that the need for absolute cleanliness from weeds amongst a maize crop during its early stages had not yet been brought home to farmers in its full significance; and crops on many farms were failures owing to this very reason which, in turn, may often be attributed to the acreage under maize on such a farm being too great for the white supervision available.

Root, Stalk and Ear Rots of Maize.

During the year, a great many observations were made on the results which are shown by maize plants following the attack of certain parasitic fungi, many of which have not yet been definitely identified, upon the roots, stalks and ears. The infection may come through infected seed, infected organic matter in the soil, or—in the case of ear rots—through wind-borne spores blown from the ground or from other infected plants. It was found that the root rots of maize are present universally extensively in the maize-growing districts of the Colony, their most self-evident effects being the large proportion of broken and fallen stems which are found on many *shambas* before harvest, especially where the type of maize

which is grown is of a soft " starchy " dent type. Descriptions of these diseases, with observations upon their incidence and suggestions for control, were included in a bulletin which was written especially for the information of Kenya farmers. This will be published before the 1931 planting season.

Investigations were also carried out in collaboration with Mr. Taylor, the officer for the Nakuru district, on similar diseases of wheat.

Giberella Saubinetti, the fungus responsible for pink ear rot of maize, seems to be specially responsible for the rotting of seed in the ground, and for the dying-off of young maize plants when only two or three inches high, with " seedling blight." A statistical plot was planted to test the effect of planting seed from cobs apparently clean from this disease, both internally and externally; from slightly infected cobs, with only one or two discoloured grains; and from more heavily infected cobs with several discoloured grains but with little or no pinking.

Untrained boys planted seed from these cobs, rejecting obviously diseased seed and only planting the grains which they considered as suitable.

The three classes of seed gave germination percentages of 90.7, 70.3 and 46.6 respectively. Neglecting the effect of the variations in spacing brought about by gappiness of stand, the bearing plants from the three groups at harvest gave yields of 7.54, 7.19 and 7.24 ounces of grain per plant, the difference not being significant. The latter result may be attributed to the large amount of soil infection occurring in the roots of plants grown on this ground from both healthy and diseased seed. Yields had been rather biased in favour of the plots grown from seed taken from the diseased cobs by planting two seeds in a hill and afterwards leaving only one plant to a hill; however, the plots grown from the good, slightly infected, and more heavily infected cobs gave yields respectively of 19.2, 16.2, and 12.8 bags of marketable grain.

Observational plots were also planted with seed from cobs infected with a fungous disease which has not yet been identified, as the Mycologist reports that it has so far failed to fruit. This diseased seed gave an evidently greater proportion of small light dry diseased cobs and ill-fertilized nubbins, as compared with the progeny of healthy seed grown in adjacent plots.

The poor plants produced by the diseased seed were more easily attacked by the Fusarium fungi which were found affecting these plants. Some cobs were affected by the same unknown fungus as was present in the seed at the outset. The land was new.

Maize Spacing Investigations.

A series of censuses of maize fields, carried out after the manner of Professor Engledow of Cambridge University, were commenced with the object of finding out the actual stands of maize which are obtained by the farmer, and of analysing the causes which lead to losses of plants. Further, these counts, followed by weighings of the produce of sample lengths of row at harvest, enable some idea to be obtained as to the actual spacing in the field which gives the best return, and also for an estimate to be made of the extent to which disease is present, and the degree to which this attack by fungi is related to the yield of marketable maize which is obtained. These censuses were taken on two fields at Kitale, one at Solai, and one at Njoro. This work will be continued in 1931. At the same time, formal but non-statistical, plots were planted in the first two weeks of April at Kitale and Solai, in the endeavour to obtain preliminary figures which would form a basis for further experiments designed to show which spacing of maize is likely to give the best results, irrespective of season, in the chief maize-producing areas. The yields obtained were high, both at Kitale and Solai, and were excellent demonstrations of the rate per acre at which maize will bear—though the season was admittedly favourable—when a sufficiency of plants are obtained per acre and a reasonable standard of cultivation is maintained. As the seed has not been specially selected for freedom from disease (except from White Blight), the stands obtained varied from only 80 to 95 per cent of those which were intended (in spite of planting at double rate), and with full stands even higher yields might be expected. The plots at Solai varied from 17.2 to 24.3 bags per acre, and at Kitale between 17.0 and 26.8 bags per acre.

The general indications were that inter-row distances of 42 and 44 inches were more advantageous than 36 or 48 inches. The closer distances in the row, from 16 to 13 inches between plants, gave the superior results, but both the censuses and the spacing experiments suggested that even closer spacings, with greater numbers of plants to the acre, would

have given even higher yields in 1930. A fuller discussion of the results from the censuses and spacing experiments is given in a Bulletin to be published early in 1931.

Maize Breeding at Njoro.

Five breeding plots were planted, the plots having been manured with boma manure at a rate of 6 to 8 tons to the acre, and subsequently with superphosphate at 100 lb. to the acre. Three ox-cultivations were given and one hand cleaning, two of the plots receiving a second, but very superficial, hand-hoeing. As an example of what may be accomplished, even at such a high altitude, when the rainfall is ample, manuring is carried out, weeds are kept down, and the stand is almost perfect, the yields from these breeding plots are appended :—

Plot 1.—Dent type, including " remnants " of cobs 55 and 148 grown in the ear-to-row trials of 1929, and surrounded by progeny cobs from the ear-to-row lines. Size, half an acre; yield, 24.2 bags.

Plot 2.—Dent type, field-selected in 1929. Size, half an acre; yield, 22 bags.

Plot 3.—Flinty type, field-selected in 1929. Size, two-thirds of an acre; yield, 21.9 bags.

Plot 4.—Flinty type, including the remnants of cobs 95, 142 and 93 from the ear-to-row trials of 1929, surrounded by progeny cobs. Size, two-thirds of an acre; yield, 23.8 bags.

Plot 5.—Kenya Flat White Hybrid, field-selected in 1929. Size, half an acre; yield, 19.2 bags. This plot suffered slightly from wash.

All plots were planted 42 by 16 inches from seed selected for healthiness. Yields are in bags of marketable grain of K.2 grade.

There was little difference between maize described as " dent " and " flinty," and it transpired that maize selected in the field from desirable plants in " dent " plots was almost invariably of " flinty " type. The Kenya Flat White Hybrid, partly through inter-crossing and partly, it may be presumed, through adaptation, has become more and more near to the usual Njoro flinty type, and it was thought no longer useful to keep those types as separate entities.

Field selection was employed in these five breeding plots, chiefly in view of securing resistance to root and stalk rots, and further selection from cobs produced by marked stems left 18 cobs with some apparent resistance to disease and actual freedom from infection. Crib selection added some 70 more cobs, chiefly of 12 and 14 rows, and, out of the total number, work will be continued with the object of producing, by the method of in-breeding, a number of high-yielding strains or hybrids with some considerable resistance to diseases which are the chief dangers to maize in Kenya.

A plot was grown in Solai from a little residual seed of the Njoro type, though not seed from the best cobs produced at Njoro in 1929. This plot, which was about one-sixth of an acre in size, yielded at a rate of over 17 bags to the acre. The cobs were better than the parent cobs, and retained the characteristic of being heavy-weighing and well covered at the tips, while the grain was of a type likely to give plants considerably resistant to root and stalk rots.

Maize Breeding in the Trans Nzoia.

Despite the apparent success of Njoro seed in its first year of removal to the warmer climate of Solai, it is felt that Njoro is likely to produce maize of a type more suited to the conditions obtaining at the higher altitudes at which maize is grown in Kenya, and that breeding for the benefit of the main maize-growing areas should be continued under conditions more typical of those under which the strains ultimately produced will be grown. It is due to the latter consideration that the maize-breeding is now being carried on chiefly in the Trans Nzoia. In addition to Fusarium diseases of maize, *Helminthosporium Turcicum* (White Blight) has to be borne in mind where work is being done on breeding maize suitable for this district. Ear-to-row trials of maize selected in 1928 for resistance to White Blight were made in 1929, and in 1930 there were selfed several plants obtained from the remnants of cobs classified by the progeny tests of 1929 as being very resistant to White Blight. The fairly resistant cobs were planted in a breeding plot for mass selection in 1930, and further cobs were obtained to be used as a starting point for in-breeding, with a view to the procuring of strains resistant to this disease. It may be mentioned that this breeding plot gave nearly 21 bags to the acre, although there were large gaps, owing to early rotting of seed infected by *Gibberella saubinetii* during the heavy rains of April and May.

A great many more cobs were selected on general plant characteristics, including apparent resistance to Fusarium diseases, from the maize growing in the spacing experiment at Kitale, while a shamba on Chorlin Estate, which was planted in February and subsequently heavily infected by White Blight, was the source of 14 cobs which remained after a second examination at harvest of cobs showing some amount of immunity to the Helminthosporium disease. It may be added that this year White Blight was not so serious in the Trans Nzoia district as it had been known previously. This circumstance was somewhat unfortunate from the point of view of maize-breeding. However, it is certain that, taking all in all, *G. saubinetii* and its companion fungi cause more damage to maize in the Trans Nzoia than does White Blight, which does not appear every year as a serious menace, and does not reduce the crop so considerably—taking a number of years into account.

Censuses of field crops have been made at Kitale, Njoro and Solai with the end of ascertaining the stand of maize actually obtained from farmers, causes of loss of plants, the optimum spacing under field conditions, and the incidence and effects of disease on the crop. At the same time, a preliminary series of spacing experiments was laid down at Kitale and Solai in order to determine, over a series of years, what are the best distances at which farmers should plant their maize in the chief maize districts.

A number of selections were made out of breeding plots at the Plant Breeding Station, Njoro, and about ninety cobs obtained as a nucleus for commencing a programme of in-breeding with the intention of producing disease-resistant strains or hybrids. The main maize-breeding scheme is being carried out in the Trans Nzoia, as a more generally suitable area, where cobs have been selected as parents from which to obtain high-yielding disease-resistant in-bred lines. White Blight is being bred against, as well as the Fusarium diseases common to all parts of the country, and a number of F, self-fertilized cobs, bred from cobs selected in 1929 as "very resistant," are among the cobs which will be planted in 1931.

Experimental Work.

Green Manure Experiment.—This is designed to show how long a green manure crop ploughed in remains effective, and to what extent.

Quantitative Superphosphate Experiment.—A four-sided latin square was laid down, testing the application of superphosphate at the following rates: 100 lb., 200 lb., and 300 lb.

Fertilizer Strip Experiments.—A demonstration strip experiment was put down, comparing boma manure against superphosphate and against the combination of the two.

Chessboard Manurial Experiment.—This experiment has been carried on from last year.

Crop Variety Trials.—With legumes for seed and green manure; other green manure crops; potatoes.

(*Note.*—A number of these experiments and variety trials have not reached a sufficiently advanced stage for publication of results. Those which have produced results of any value have been incorporated for publication of results in the Bulletin referred to under the heading "Field Experimental Work" in the Director's section of the Annual Report.)

Experimental Sample Plots of Trees.

In co-operation with the Forestry Department, two acres of land were prepared and planted up with thirty-four species of trees. The varieties chosen were those which were likely to be suitable to the district and include eighteen species of eucalyptus and five species of cupressus.

Buildings.

A concrete grain store and a threshing barn were erected by the Public Works Department. The maize crib was enlarged and a two-roomed building, made of murrum blocks, erected for the use of the junior laboratory assistant.

A combined grain store and laboratory was erected at the Scott Agricultural Laboratories, the Plant Breeder's previous laboratory being taken over by the officer working on grasses.

Plague.

Rats were very numerous during the rains and plague was prevalent in the district. All the staff and labour were inoculated, and no cases of plague were reported on the station, though deaths occurred on neighbouring farms. The station is situated in Njoro township, and it is desirable that permanent quarters for the labour should be erected.

G. J. L. BURTON,
Senior Plant Breeder.

APPENDIX VIII.

REPORT ON INVESTIGATIONAL WORK ON ANIMAL NUTRITION.

By The Rowett Research Institute.

The feeding tests described below have been carried out by the Rowett Research Institute on the Naivasha Stock Farm with live stock supplied by the Government of the Colony. The experimental work is under the auspices of the Empire Marketing Board, which has made a grant of funds for the purpose.

1.—Milk Cows, Feeding Test.

(*a*) *Effect of feeding simsim* (*sesame*) *cake on milk production.*—Two groups of cows, eleven in each group, balanced as nearly as possible in respect of age, breed, stage of lactation and milk yield over a preliminary period of sixteen days, were recorded during an experimental period of 4½ months. One group, serving as control, received no additional feeding; while the other group was fed simsim cake according to milk yield, up to 3 lb. per head per day. At the end of the period, the cake-fed group showed an increase of 13 per cent milk yield for the period. The value of this increase covered the cost of food and labour, but the profit per cow per day was practically negligible.

(*b*) *Effect of feeding green maize on milk production.*—Two groups of eight cows, selected as above, were recorded over a period of two months, one group being fed green maize daily. An increase in milk yield of 20 per cent was obtained as the result of feeding green maize.

During 1930, owing to the high rainfall, grazing conditions were exceptionally favourable to milk production, hence no striking results from the supplementary feeding described above were anticipated. As the pasture dried up, the beneficial effects of the supplementary feeding became more evident.

2.—Calf Feeding Test.

An experiment with hand-reared calves, with the object of reducing the normal ration of whole and separated milk, has been concluded. Two lots of ten calves, balanced in respect of age, birth weight and sex, were fed on different quantities of whole and separated milk, the calves receiving the low milk ration having a supplementary mixture rich in minerals and protein added to their daily ration of concentrates.

The quantities of milk per head fed to the two groups were :—

(*a*) Control Group : 45 gallons whole, 80 gallons separated milk.

(*b*) Experimental Group : 30 gallons whole, 70 gallons separated milk.

After six months, the control group of calves on the high milk ration showed an average daily gain in weight during the period of 1.09 lb., while the figure for the low milk group was 1.06 lb. In appearance, both groups were alike when weaned at six months.

3.—Sheep Feeding Tests.

(*a*) A supplementary mineral feeding test with wether hoggets was carried out on the high country in the Gilgil district, where the pasture was believed to be deficient in essential minerals. Two groups of fifty wether hoggets were treated as follows :—

Group 1 received coarse salt in addition to pasture.

Group 2 received equal parts of coarse salt and bone meal with a trace of potassium iodide.

Both groups ran on the same grazing, and after a period of eight months Group 2 showed an increased rate of growth of 18 per cent over Group 1.

(*b*) A similar test was carried out on the Naivasha Farm with lambs weaned in June, 1930. Three groups of lambs, with 40 ewes and 40 wethers in each group, were selected and treated as follows :—

One group received coarse salt plus bone meal plus a trace of potassium iodide. Another group had access to rock salt, while the third group received no mineral supplement.

The rate of growth during the period of six months after weaning was slow in all groups, but definitely in favour of the groups receiving the minerals. The main interest of the experiment was in its bearing on helminthic infestation. During the test four lambs from the control group and three from the rock-salt group had to be withdrawn on account of debility from worm infection, while there was no evidence of helminthiasis in the group receiving the mixture of salt, bone meal and iodine.

4.—Pig Feeding Test.

An experiment was carried out with weaned pigs to determine the effect on the rate of growth and quality of carcass when foodstuffs rich in minerals and protein were added to the cereal ration in lieu of separated milk. Two pens of ten pigs each, balanced according to age, sex and weight, were fattened as follows :—

Group 1 received a cereal ration (maize and middlings), plus 5 lb. separated milk per head per day.

Group 2 were fed the same cereal ration, and, in place of separated milk, meat-meal and earth-nut cake in equal parts were substituted, one part of this protein-rich supplement to five parts of the cereal ration.

The pigs were weighed at 20-day intervals, the food consumed per pen was recorded, and the cost of fattening each pen estimated. When the pigs were fit for slaughte , the carcasses were examined individually by the Live Stock Officer, Department of Agriculture, at the Uplands Bacon Factory. A summary of the experimental data is given below :—

	Av. Initial weight lbs.	Av. Final weight lbs.	Av. Gain lbs.	Cost per lb. live weight increase	% Carcass to live weight
Group 1 (milk)	46·7	185·6	138·9	14·4 cts.	81%
Group 2 (Cake and meat meal)	46·6	180·0	133·4	18·4 ,,	79%

Both pens of pigs had reached the bacon stage at the same time, and a thorough examination of the carcasses after slaughter showed that for bacon purposes there was no difference in the quality of the two pens as the result of the different rations used in fattening. The substitution of meat meal plus earth-nut cake, when separated milk is not included in the ration, produced favourable results in respect of rate of growth of the pigs and the quality of the carcasses when they were slaughtered for bacon.

H. GUNN,
Officer in Charge of Investigations.

APPEN

METEOROLOGICAL OBSERVATIONS TAKEN AT CERTAIN STATIONS IN

Registered No.	STATION	Latitude	Longitude	Height above sea-level	Pressure at Station level	Dry bulb	
				Feet	Inches	°	
90.3501 (58)	Kericho Jamji Estate.. ..	0°29′00″S.	35°12′00″E.	6,000	—	—	
90.3504 (53)	Kericho-Karabwet	0°23′00″S.	35°20′00″E.	6,700	—	—	
90.3510 (189)	Lumbwa-Kipkelia	0°14′00″S.	35°30′00″E.	6,506	23·790	—	
90.3524 (34)	Lumbwa—Industrial Mission	0°20′00″S.	35°21′00″E.	6,900	—	—	
91.3601 (232)	Nairobi Loreto Convent ..	1°16′00″S.	36°46′00″E.	5,700	—	59·7	57
91.3608 (63)	Kabete Reformatory	1°14′00″S.	36°44′00″E.	6,000	—	62·9	59
91.3610 (91)	Nairobi, Dept. of Agriculture	1°16′00″S.	36°50′00″E.	5,495	—	—	
90.3616 (111)	Nakuru, Shura Farm.. ..	0°20′00″S.	36°00′00″E.	6,500	—	—	
91.3621 (53)	Limuru, Togi Farm	1°06′00″S.	36°39′00″E.	7,400	—		
91.3625 (27)	Nairobi Scott Agr. Laboratory	1°15′00″S.	36°46′00″E.	5,700	—	—	
91.3630 (—)	Kabete Observatory	1°16′00″S.	36°48′00″E.	6,004	24·274	61·0	
91.3710 (64)	Machakos D. C.	1°31′00″S.	37°16′00″E.	5,400	—	—	
94.3702 (—)	Mombasa Observatory ..	4°04′00″S.	39°42′00″E.	75	—	81·4	75
92.4001 (52)	Lamu D. C.	2°16′00″S.	40°50′00″E.	10	—	—	

X IX.

THE COLONY AND PROTECTORATE OF KENYA FOR THE YEAR 1930

TEMPERATURE					Departure of wet bulb	Percentage Hu.	Wind force	Amount of cloud	RAINFALL.					
MEAN			EXTREME											
Maximum	Minimum	Max. & Min. combined	Maximum	Minimum					Total amount	Greatest fall	Date	No. of days' rain	Average	Period of years
°	°	°	°	°	°	%			In.	In.		No.	In.	No.
80·6	50·2	65·4	90	41	3·9	91	—	3·3	72·02	2·20	3–10–1930	256	62·46	8
77·4	49·3	63·3	89	41	—	—	—	2·6	79·45	4·00	8–8–1930	207	71·97	18
75·0	51·0	63·0	83	41	5·9	73	0·9	2·8	54·36	2·07	24–3–1930	181	41·39	12
—	—	—	—	—	—	—	—	—	76·81	3·10	8–8–1930	222	70·65	18
75·4	54·6	65·0	86	39	2·2	88	0·8	7·7	72·59	4·14	22–5–1930	148	41·26	8
74·6	52·7	63·6	85	37	3·8	81	1·9	—	61·57	2·73	22–5–1930	169	46·21	11
No Records			—	—	—	—	—	—	61·80	3·08	31–1–1930	—	36·74	15
No Records			—	—	—	—	—	—	51·86	1·99	26–7–1930	197	37·71	24
68·6	48·7	58·6	78	38	2·5	87	—	—	83·15	3·82	25–2–1930	257	54·17	23
73·4	54·7	64·0	83	42	4·9	76	—	7·1	72·00	5·22	22–5–1930	150	39·65	7
70·6	54·3	62·4	80	44	—	82	—	—	66·13	3·41	23–5–1930	159	52·84	2
No Records			—	—	—	—	—	—	50·53	2·60	15–10–1930	101	36·50	36
85·8	75·1	80·4	94	68	6·1	76	—	—	39·53	3·18	16–4–1930	155	46·44	40
83·9	74·8	79·3	89	67	1·0	96	—	5·3	34·25	4·02	12–5–1930	68	36·70	23

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